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GAS JOURNAL

LIGHT • HEAT • POWER • BYE-PRODUCTS

[Founded in 1849 as the "Journal of Gas Lighting."]

VOL. CLXVII. No. 3196.] LONDON, AUGUST 13, 1924. [76TH YEAR. PRICE 1s.

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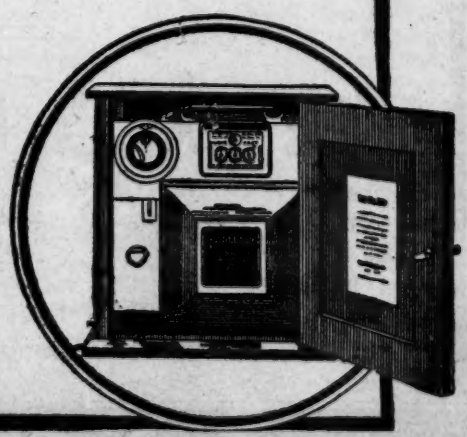

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VOL. CLXVII., No. 3196.] WEDNESDAY, AUGUST 13, 1924. [76TH YEAR.

EDITORIAL NOTES.

Lessons of Mr. Butterfield's Report.

THEY are many; and no one must allow the National Gas Council's criticisms of the basis of statistical comparison to detract from the intrinsic value of the report. Last week we dealt with the summary of the conclusions and the recommendations. Several hours have since been devoted to a study of the main report; and we must say at once that Mr. Butterfield has skilfully lifted the carbon monoxide question out of the rut into which academical consideration had placed it, and put it into a position from which it cannot be dislodged. Had it not been for this report, we are convinced that any small and temporary recurrence of gas poisoning would have resuscitated the outcry for a limitation of carbon monoxide in town gas supplies, which is the sole direction of appeal of those who have made merely superficial examination of the problem, and who have confined themselves to one line of thought, and put forward one pseudo remedy. Now Mr. Butterfield in this report has conclusively proved two things: (1) That the statistical evidence does not support the idea that fatalities from gas poisoning have relation to the percentage of carbon monoxide in gas; and (2) that the economic interests of the public will not be served by any restriction. He has also sought to show that the practical line of attack in reducing fatalities from the already low average is in systematic inspection—periodically and with such frequency as is demanded by the conditions which in supply areas assail the integrity of fittings and appliances or assist in their preservation in good working state. The fact that Mr. Butterfield has constructed his argument and case on the basis of premises supplied, instead of carrying it farther on—that is, to the numerous points of use in those premises—is something that is distinctly in favour of the gas industry, because it leaves in hand the margin provided between the increase in premises and the increase in points of use in the premises supplied. We want particularly to emphasize this, because it is an advantage to the industry to be in possession of additional debatable ground. The report, in short, has placed this important matter on an altogether higher plane than it had reached by prior investigations by Departmental Committees. Those inquiries were limited by a consideration as to whether the risk of gas poisoning would be reduced by restricting the percentage of carbon monoxide in town gas; but after this painstaking research and the conclusions of the investigator, there will never again be room for approaching the subject from the one and only road along which previous hostility had endeavoured to drive it. The report and the recommendations cover upwards of forty pages. Those forty pages do not convey to the reader the amount of patient, diligent, and penetrating work which had to be done before the document could be produced. Those who have been clamant for limitation of carbon monoxide in town gas have never backed-up their case by work such as this; they have sought to forge a new shackle for the industry without being able to advance any data from experience in support of what they tried to do. In other words, they endeavoured to make assumption work as effectively as fact. Probably the data were not available to them as to Mr. Butterfield; but the point only shows how poor was the ground on which they made appeal for restriction. The report before us is invaluable to the gas industry; and from it this acknowledgment is due.

The point from which Mr. Butterfield approached the question was that gas which contains larger quantities of carbon monoxide than does straight coal gas is not inferior from the hygienic standpoint, except when it escapes unburned into a room, and then it is only a question of degree in comparison with coal gas. Therefore, in view of the economic advantage to gas consumers of the employment of coke in the manufacture of gas, the obvious thing to do is to ascertain whether anything can be done to reduce the risks of gas escaping. That is the only sensible course, seeing that deaths from gas poisoning occur in districts where straight coal gas is supplied with its 7 or 8 p.ct. of carbon monoxide. Mr. Butterfield's original and careful researches prove that in practice the increasing admixture of gas (during the past thirty years) containing a larger percentage of carbon monoxide has not affected materially the number of fatalities from accidental gas poisoning; and that the variations in the number of fatalities depend primarily upon other factors than the difference in the proportion of carbon monoxide in the gas. Could the researches over the thirty years have been made by comparing points of use instead of premises, the truth of this would have been accentuated still more forcibly; but it must be recognized that Mr. Butterfield was compelled to work upon the safest data that he had at hand.

Among the fallacies that have hitherto been accepted without much thought in connection with the consideration of this subject has been that the maximum proportion of carbon monoxide present in the gas at any one time was the factor which determined the risk of accidental poisoning from an escape; but it is laid down in the report that there seems to be no question that in reality, in so far as such difference in composition may have effect on the risks, such effect would on the whole be determined by the "average" proportion of carbon monoxide in the gas supplied in the different areas. In this matter, the futility of spasmodic analyses of gas supplies is emphasized; and Mr. Butterfield advances a useful formula which enables a sufficiently approximate determination of the carbon monoxide in a gas to be made, the percentages of coal gas and water gas being known. In the case of steaming in vertical retorts, he suggests that 12,700 c.ft. should be taken as representing the yield of true coal gas, the balance being regarded as water gas. The formula has enabled Mr. Butterfield to make an exhaustive investigation, from the annual returns of the Board of Trade relating to statutory undertakings, to ascertain, with tolerable precision, the average proportion of carbon monoxide in the gas supply in any year of any undertaking. By this means, definite information has been obtained by which to test the truth of the statements which have been freely promulgated to the effect that large increases have taken place in recent years in the proportion of carbon monoxide in the gas supplied by gas undertakings, and in particular by certain undertakings in whose districts there happens to have been an increase in fatalities by poisoning or from accidental escapes of gas. Those statements are without foundation. It is perfectly clear that such increase in fatalities as there has been has followed *pari passu* the increase in the use of gas, and not any increase in the proportion of carbon monoxide in it. We hope that Mr. Butterfield does not include the "JOURNAL" in his censure for oversight, when he says that it is curious that the enormous growth in gas supply in the last thirty years has been generally overlooked when the question of fatal accidents due to gas poisoning has been under discussion, and that more stress has been laid on small changes in the composition of gas than on the rapid increase in the number of premises which receive a supply from the street mains. We have on more than one occasion pointed to the omission, on the part of those who sought restriction being placed on the carbon

monoxide content of gas, to take into account the increase in the number of consumers and in the consumption of gas by them.

As is mentioned in the report, the year 1891 was the last one in which coal gas only was supplied in England and Wales; and from the introduction of water gas at that time its use continued to grow. But in 1891, the number of premises supplied with gas was 1,959,393, while in 1922 the number was 6,902,465—an increase of rather more than 252 p.ct. There were fifteen deaths from gas poisoning registered in 1891; and had the conditions as to composition remained unaltered, one might have expected at least 53 deaths in 1923. But for the first nine months of last year, the number of deaths was 56, four of which were undoubtedly caused by the products of imperfect combustion, and were not due to the presence of carbon monoxide in gas. There we have it proved that in proportion to premises supplied, there has been no actual increase in fatalities between the coal-gas and the mixed-gas era.

Among other lessons drawn from the report are the wide fluctuations in the number of deaths from year to year, though a fair constancy has obtained in respect of the proportion of carbon monoxide in the gas; and yet the heaviest number of deaths from gas poisoning in any one year is small in relation to the widespread use of gas. Mr. Butterfield comes to the deliberate conclusion from the mass of tabulations which he has made in relation to many succeeding years, from the classification of gas undertakings in respect of magnitude, and from a comparison of fatalities with premises supplied and population in those premises, that the Legislature was right in not acting on the recommendations of Lord Belper's Committee in 1899. As we have already said, a better showing still could have been made had data been available regarding the increase in the points of use in the premises supplied. That this was present in Mr. Butterfield's mind is patent from his incidental references to the changes which have been effected in the use of gas since 1899; and particularly when he says that, unless allowance is made for the influence of the changes in use mentioned in the report, totally erroneous conclusions may be drawn from his tabulated statement. He adds: "Any "observed increase in the death rate cannot properly be attri- "buted to an increase in the proportion of carbon monoxide "in the gas supplied unless it is first proved that the conco- "mitant changes in the uses of gas have had no appreciable "effect on the risks of gas poisoning." The investigations establish the fact that in the areas of 613 gas undertakings supplying small towns and rural areas (in which were 1,607,647 premises, of which 800,140, or rather less than half, were supplied with ordinary coal gas, while 807,507 were supplied with gas containing a higher proportion of carbon monoxide), in ten years 49 deaths occurred in the areas supplied with coal gas, and only 42 in the areas supplied with gas containing more carbon monoxide. That is a remarkable answer to those who have sought to establish a connection between accidental deaths and the carbon monoxide content of gas, and to limit the percentage of the latter. The information carries another lesson. It is that the risk of accidental death is so small in the class of areas referred to that it is not unreasonable to describe it as negligible. Another striking fact is that in the districts of supply of no fewer than 538 of the small authorized gas undertakings, there were no accidental deaths attributable to gas poisoning throughout the ten years 1913-22, though 1,229,952 premises were supplied with gas, and 48 p.ct. of them received a supply containing more carbon monoxide than ordinary coal gas. We cannot here follow closely all the data supplied by Mr. Butterfield; but in his next grouping —medium-sized towns—the statistics do not suggest any appreciable growth in the death rate from accidental gas poisoning in the course of the ten years. In the areas of 54 large undertakings supplying densely populated areas—where the conditions of living are not the same as in the other areas, where there is more general use of gas for cooking, heating, and water heating, and where in the older houses there has been a greater deterioration of the internal gas piping and fittings—the fatalities for the last 10¾ years average as nearly as possible one per annum per 75,000 premises supplied, or one per annum per 300,000 persons who make use of gas.

It is certain that Mr. Butterfield has been convinced by laborious research that the wide divergencies in the death rate from accidental gas poisoning in towns supplied with ordinary coal gas, and the comparatively high rate in certain of those towns, make it clear that, in modern conditions, very little greater security would be afforded to gas consumers if all the undertakings reverted to the supply of ordinary coal gas, and in other directions took no further precautions than at present. Looking at this finding, at the differences in the conditions of fittings in the densely populated areas compared with the country districts, at the more rapid deterioration through corrosion of the piping and fittings in towns on the coast compared with those farther inland, and at the lower average of deaths from prepayment systems than from ordinary, it is possible easily to follow the direction in which Mr. Butterfield's opinions were directed by his exploration for means to reduce still further what must be recognized as a low average of fatalities in relation to the widespread use of gas. Hence his main recommendation as to the institution of a scheme of periodical inspection of piping and fittings. He believes this would reduce the fatalities by 50 p.ct.; perhaps by as much as 60 p.ct. But if there is to be inspection, let it be of a complete order, and not subject to the sanction of either owners or occupiers. There would be little use in a partial system. The obligation to inspect must be accompanied by the power of entry, otherwise the efficiency and effects of the inspection will be much impaired. In last week's issue, there were some comments on the recommendations. We will not revert to them on this occasion, but will wind-up this review of a valuable report with a reference to Mr. Butterfield's counsel to coroners. He says they should require more definite proof of gas poisoning than such simple evidence as "a smell of gas was noticed in the room when the victim was discovered, and that it was traced to a small leak from a defective tap or joint." The "more definite proof" should be provided by a proper examination of the blood before a verdict of gas poisoning or carbon monoxide poisoning is returned. Coroners are as prone as many other people to follow a fashion; and from coroners a good deal was heard, on the flimsiest of evidence, as to deaths being due to carbon monoxide, when the "Daily Mail" and other omniscient papers were trying to lead public opinion to the conclusion that most ills to which humanity is heir are due to that particular gas.

Poaching Unions.

There are some trade unions that appear not to have a code of honour which they strictly observe and keep inviolate. Some of them have no scruples whatever as to attempting to encroach upon the legitimate and prescriptive rights of other unions, in order to increase their own membership and the area of their power. The Operative Plumbers' and Domestic Engineers' Association (with whom in this regard are identified the National Federation of Building Trade Operatives) provide a case in point. For some time past—for two or three years, in fact—gas undertakings in the Midlands and in Scotland, and the National Joint Industrial Council for the gas industry, have been troubled with the claims, actions, and pretensions of the Plumbers' Association. It is time a stop was put to this; and if all gas undertakings that are attacked will only do the same as Nottingham and Derby have done, and see this matter through, an end must come to the poaching and the unreasonable attitude of a Union which cannot show, much less prove, that they have any rights such as those to which they lay claim. Incidentally, in doing this the gas undertakings will be protecting the National Union of General Workers, which is the chief body representing the interests of gas workers upon the Industrial Council for the Gas Industry, upon which Council the Plumbers' Association have no representation. Gas-fitters are not plumbers, and plumbers are not gas-fitters; nothing but a special course of training in the respective crafts could make of the one the other. Moreover, the Plumbers' Association until the last two or three years have never preferred a claim to the incorporation of gas-fitters in their ranks; and always, since these questions have been treated on a national basis, in dealing with wages, hours, and conditions of gas-fitters as of other gas workers, discussion and agreement have been with the Gas Workers' Union, and now the National Union of General Workers, with whom the old body is affiliated. Though the Joint Industrial Council have frequently considered the claims of the Plumbers' Association, they can find no justification for them; and therefore they are determined not to be forced into recognition or acceptance. It is hoped that no gas undertaking will allow itself to be

bullied into a false position in this respect. The gas industry has right on its side, and in this matter its interests are with the National Union of General Workers, with whom its dealings and collaboration have hitherto been carried on. There have been no dealings with any plumbers' organization.

A favourite game of the Plumbers' Association, if recognition is not made of them when they claim that gas-fitters should be catered for by them, is to threaten to stop housing schemes being proceeded with—by calling a strike of their members, hoping by forcible methods so to secure the transfer to their organization of gas-fitters from their present Union. Where there is thorough resistance on the part of the municipal body or company attacked, there is failure on the part of the would-be poachers. Nottingham resisted for many months; and the strike there (with a municipal body loyal to the National Joint Industrial Council) collapsed. Now there has been the strike at Derby, as noticed in our news columns last week. This strike was confined to Corporation houses, and was ordered with the view of putting pressure on the Derby Gas Company to persuade or compel their fitters to leave the National Union of General Workers and join the Plumbers' Association. The Derby gas-fitters lay no claim to being plumbers; and they state that, if they left the Company's employ, they could not obtain work as plumbers elsewhere. Therefore they declined to transfer their membership at the bidding of the Plumbers' Association. With this action the General Manager and Engineer of the Company (Mr. J. Ferguson Bell) agreed, and promised the men that they should remain free agents. The strike collapsed as soon as the Corporation intimated that, unless the plumbing work on their houses was completed without further delay, they intended to have it done by authorized plumbers. For several weeks previously, this course had been pressed upon them by Mr. Bell. In 1922 there was a similar strike in Derby; and it continued some three months. This last one had a run of eleven weeks. In both cases, the result was the same—the men returned to work upon the terms and conditions that existed when they left it. We believe that this was looked upon as a test case. But as the result of the independent action of the Gas Company, there has been this second defeat on the same ground—a union desiring to increase its membership by trespassing on the preserves of other Unions, and forcing men against their better judgment to transfer their allegiance.

In view of the aggressive action taken by the Plumbers' Association in Derby, Nottingham, and other towns, it is highly important that gas undertakings should decline to enter into any agreement with that body. The National Joint Industrial Council will not recognize them, nor will the Federation of Gas Employers; for the reason that no legitimate ground exists for the claim that gas-fitters should be plumbers. The only object of classifying them as such would be to swell the membership of the marauding organization, and that is not a sufficiently good reason for the gas industry, which is determined to stand by the National Union of General Workers in this particular.

The Wanted Balance.

THE past few days have brought us several acknowledgments, personal and otherwise, as to the excellence of the appeal made through the Supplement in last week's issue for the balance of the money and men required to carry out fully the programme arranged in connection with the Gas Exhibit at the British Empire Exhibition. We wish, however, to say that our desire to serve, by the method determined upon, the interests of the gas industry in this respect could not have had effect given to it without the generous response made to the invitation to supply us with personal testimony from within the industry. Once more we heartily thank those who supplied the material which appeared in the Supplement. The invitation was sent broadcast—to representative men of all ranks, positions, and interests in the industry, and there was no prior knowledge as to what would be the result. Our own selected standard for judging the success or otherwise of the Exhibit had been, and is now, the extent (from personal observation and that of the members of our staff) of public attraction and interest, and that has been good; and good has grown, with the enlargement of public attendance at the exhibition, to excellent. It was a pleasure to find that the view we had formed as to the Exhibit had such unanimous endorsement in the industry. The Exhibit is the industry's contribution to an imperial display; and, in its own interests, the industry must develop from it the maximum in propaganda work. This can only be accomplished by effort and expenditure. A moderate calculation of 6s. per million c.ft. of gas sold in 1923 would supply all the funds required to complete the plans. Many undertakings have put down that amount freely, and have endorsed the sums as money well spent. There are some undertakings that have not yet contributed a penny; there are others that have not subscribed up to the standard rate of 6s. per million c.ft. sold, or 0·072d. per 1000 c.ft. If they do their part, the balance of funds required will be forthcoming. In the gas industry, and in these matters, let all share alike in proportion to their magnitude in terms of gas sales.

New Clauses.

THE season is approaching for settling the composition of Bills for promotion in Parliament, and for considering the powers to be sought in Special Orders. It is very necessary that no clauses which are departures from the normal should be inserted in any measure without doing everything possible to ensure that they will not be damaging to the interests of the industry as a whole. This applies also to agreements with local authorities, railway companies, and other bodies, who are more intent than ever on securing clauses to their special advantage, and to be used as precedents. More often than not they are of an order which is eventually irksome to those who accept them with the view of promptly getting quit of temporary hostility, and are troublesome to subsequent promoters, who find that success in one case encourages those who obtain conditions specially favourable to themselves to press for them in all succeeding cases. It is therefore better in connection with novel clauses or provisions proposed by opponents, and unusual in character, to consult the National Gas Council regarding them. No administrators of a gas undertaking want deliberately to injure their own interests, or to do anything which will be harmful to the interests of the industry; and the best protection against this is to consult the central authority, who have the necessary knowledge and resources at command to give sound advice in these matters. "One for all, and all for one," applies as much to these legislative questions as to the development of our gas-trading interests. A slip may do irretrievable harm not only to the promoters of a measure, but to many others; and it is a responsibility upon each undertaking to guard against this. The Central Executive Board of the National Gas Council have repeatedly referred to this matter as being of vital importance; and they have again issued timely warning, which it is earnestly hoped will be observed. There is no question of the Council's wishing to act arbitrarily or dictatorially; their only desire is to assist in averting anything which might be in any way detrimental to the general interests of the gas industry.

The Recess.

Parliament rose last Thursday for, it is hoped, a long respite from their labours. They will meet again according to resolution on Tuesday, Oct. 28, unless the position of the Irish boundary question necessitates the calling together of the House on Sept. 30. Meanwhile, we are having a little relief from inquiries into Orders for which applications have been made under the Gas Regulation Act. The Director of Gas Administration has had a busy time this year, not only with applications under section 1 of the Act, but with inquiries under section 10; and he and his staff have fully earned a holiday.

Diversion of Mains.

It is to be hoped that municipal authorities throughout the country will view from the standpoint of justice the question of the incidence of the expenditure involved in altering the position of pipes and cables in roads undergoing diversion or improvement—particularly those authorities who do not trade in gas, electricity, and water. Those with such undertakings under their care will, we should imagine, refuse to agree with the London County Council that "the grant to private statutory companies of the right to use public streets without charge for the purpose of laying down pipes or wires ought not to involve an obligation upon the local authorities to keep such streets unaltered for ever, or, if they be altered, to bear the cost of any necessary removal or

relaying of the pipes or wires." What applies to statutory companies in this regard should also apply to the similar concerns of municipal authorities; and to apply it to them would be equally as unfair as applying it to private companies—that is to say, where the municipal undertakings are rated up to the hilt, as is invariably the case with statutory companies. Public utility concerns are under many limitations and obligations. They are compelled to carry on their services under conditions prescribed by Parliament; they contribute to the costs of local government (including road improvements) through the rates, and, in fact, are highly important contributors. Therefore it is only equitable that highway authorities should bear the cost of the removal or relaying of mains or cables occasioned by road improvements, or the diversion of a highway or highways.

Wembley Next Year.

Daily newspapers announce that the Executive Council of the British Empire Exhibition at Wembley have decided to keep the exhibition open next year. If this is true, probably those who have exhibits there will require a little time to learn particulars as to what will be expected of them, and also to arrive at a decision regarding the matter. It is stated that one indirect advantage of the decision will be that it will give employment during the winter months to a large number of people in looking after the buildings and the exhibits.

Electricity Collapses at Wembley.

One of the features of the electricity supply industry is that it cannot guarantee a continuity of supply. Being a feature, it is perhaps only right, though inconvenient, that it should be demonstrated at the British Empire Exhibition. There has been no failure there in demonstrating failure. Extinctions have taken place at various times. There was a cessation of supply last Wednesday evening. Some sections of the grounds were plunged into darkness. The "Never-Stop" railway was compelled to abuse its title; and where electrical energy is the propelling force in the Amusements Park, there had also to be stoppage in money-taking—much to the annoyance of those concerned. The Wembley gas-lamps smiled cheerfully, but not unkindly, over the lapse of their vagarious competitor.

Aggregate of Small Savings.

There is a proneness sometimes to neglect the small economies. That is a mistake. Their aggregate may be considerable. Economies are effected in various ways—sometimes by the lessened expenditure of material, time, heat, or power in obtaining a given result. We were struck the other day by an appeal by Sir Ralph Wedgwood, the Chief General Manager of the L.N.E.R., to the enginemen on the 7000 miles of railway under his control. He said: "Coal costs 22s. per ton. We use 4¼ million tons a year. Our coal bill is thus £4,675,000. If every locomotive burned 1 lb. of coal less for every mile it ran, the Company would use 75,000 tons less in a year, and save £80,000. Will every engineman help his Running Superintendent to get this economy?"

Low-Temperature "Conservation" Process.

Low-temperature carbonization advocates are getting the utmost publicity possible from the fact that a low-temperature plant is being erected at the Digby Colliery, Nottingham, to treat 1000 tons of coal per day. A contract has been entered into with the Corporation for the supply to them of the gas made; and naturally the smokeless fuel produced will be immediately available to Nottingham. But what is going to happen from this? Many wonderful things are predicted. Nottingham is eventually to become a smokeless city. Nottingham has our congratulations. Of course, it is the Digby Collieries which are doing this; but in the newspaper references the credit is given to the city. Nottingham, it is said, is about to put into actual practice a policy of coal conservation which is a matter of the deepest concern to the country. Then a terrible prediction: Without this form of coal conservation we shall not exist at all; and why? Because "when treated by the low-temperature 'conservation' process, our coal will provide all the motor spirit, Diesel, lubricating, and fuel oils that this country now imports from abroad." We congratulate Nottingham, the nation, and above all the low-temperature "conservation" process. Oil is described as the prime essential of modern industry. The Government thinks electricity ranks first; we of the gas industry are modestly inclined to believe that the claims of gas to prominent rank should not be ignored. About oil, the low-temperature advocates point out that a world shortage of oil is threatened. What does it matter with low-temperature carbonization available? They tell us that every 1000 tons of coal of average quality that is burned represents a loss of 3000 gallons of motor spirit and 16,000 to 18,000 gallons of fuel oil. The Digby Colliery plant will be welcomed; for it will inform us of actual results where at present we have had only theory, experimental data, and years' of wordy claims as to the wonderful potentialities of the low-temperature system in comparison with high-temperature working. We are not denouncing low-temperature carbonization for certain purposes; but we do object to exaggeration, of which in this connection there has been a bulk supply. Both the technical and the commercial results from the Digby Collieries will be welcomed, whatever their nature.

Slump in Trade Union Membership.

The Trade Unions have suffered severe losses in membership; and it is not therefore surprising that they are energetically operating to induce employers to insist on all workers becoming members of their appropriate organization. We believe in freedom, and do not agree with men being compelled against their will to enlist in the ranks of trade unionism. The report of the Chief Registrar of Friendly Societies for 1922 states that the membership of registered trade unions, which reached nearly 7 million persons in 1920, and has since been steadily falling, was reduced to 4¼ millions in 1922. In that year alone, there was a loss of nearly 1 million members. Their funds, in spite of a corresponding reduction, still exceeded £10,000,000. During the year, they spent more than £8,000,000 in unemployment benefit, which, following on the £15,000,000 expended in the preceding year, serves as some indication of the extent of trade depression. The amount expended in dispute benefit was smaller than in any year since the war.

CARBON MONOXIDE AND CATALYSIS.

In an abstract from an article which appeared in No. 4 of "Brennstoffchemie" this year, "Das Gas- und Wasserfach" state that Fester and Brude have established some interesting facts with regard to the behaviour of carbon monoxide in the presence of catalysts. With exclusion of air, carbon monoxide can be split-up either according to the water-gas equation or by intermolecular oxidation and reduction according to the equation $2CO=CO_2+C$. This reaction, which formerly could be effected only at comparatively high temperatures, can be so advanced by catalysis that even at temperatures below 100° C. carbon dioxide is formed in appreciable quantities. The authors used palladium as the catalyst, deposited in a finely-divided state on strongly adsorbent carriers, such as activated charcoal or silicic acid. Carbon monoxide was passed over this catalyzing agent, which was maintained at a known temperature in the combustion tube, and the issuing gases were analyzed. According to the temperature, and the rate at which carbon monoxide was passed, the percentage of carbon dioxide in the issuing gases amounted to 0·6 to 16·1 p.ct., but in every instance the efficiency of the catalyst showed rapid depreciation. This, in agreement with other investigators, the authors attribute to the preferential adsorption by the catalyst or its carrier of the product of the reaction—in this case carbon dioxide. In this way the diffusion of the carbon monoxide over it, and consequently the reaction, is interfered with. Nevertheless, experiments showed that at 50° C. carbon monoxide could be split-up up to 4 p.ct. by catalysis. Activated charcoal proved more effective than silica gel. The effect of the palladium catalyst in speeding-up the reaction in the case of the oxidation of carbon monoxide with oxygen was perceptible even at room temperatures, but the preferential combustion of the carbon monoxide before hydrogen could not be achieved, at any rate in the presence of palladium catalysts. However, by using vanadic acid, when the two gases were present in almost equal quantities, at 450° C. and a stream velocity of 6·5 mm. per minute, they succeeded in burning almost three times as much carbon monoxide as hydrogen. When the partial pressure of the former is low, this proportion moves greatly in favour of the hydrogen, so that the removal of small quantities of carbon monoxide from hydrogen cannot be worked by this method. A solution of vanadin pentoxide shaken up in a burette shows the same oxidizing action towards carbon monoxide as does chromic acid. Experiments in the direction of reducing carbon monoxide to ethylene by means of hydrogen in the presence of nickel-palladium catalysts were attended by no success, so that the indications of Orlow could not be confirmed.

PERSONAL.

Mr. R. E. GIBSON, Engineer to the Liverpool Gas Company, has been elected President of the Liverpool Engineering Society for the year 1924-25.

In anticipation of his marriage, which has been arranged to take place at St. Martin's Church, Hereford, on Aug. 20, his colleagues on the various Corporation staffs have presented Mr. ARTHUR R. W. ROBERTS, the Hereford Gas Engineer and Manager, with a handsome silver tea service. The presentation was made by the Town Clerk (Mr. R. Battersby). The Mayor (Mr. A. Kear) and several Corporation officials made felicitous speeches reflecting the popularity and appreciation of Mr. Roberts in civic circles in Hereford, and the ability he has displayed in the management of the works for the past ten years. Mr. Roberts suitably acknowledged the presentation.

Prof. HORACE LAMB, LL.D., D.Sc., F.R.S., of Trinity College, Cambridge, has been elected President of the British Association for 1925. The new President was a Fellow of Trinity College, Cambridge, from 1872-5, was Professor of Mathematics at the University of Adelaide from 1875-85, and held a similar position in the Owens College and University of Manchester from 1885-1920. In 1904 he was President of Section A of the British Association in Cambridge.

Messrs. W. Sisson & Co., Ltd., of Gloucester, have appointed as their London representative Mr. A. FLEMING BROWNE, M.I.Mech.E., M.I.H.V.E., Drying, Heating, and Ventilating Engineer, of No. 11, Carteret Street, Queen Anne's Gate, S.W. 1.

OBITUARY.

The Liverpool Gas Company have lost a Director of fifteen years' standing by the death of Mr. EDWIN ARTHUR BEAZLEY. Senior partner of a well-known firm of shipowners and brokers, Mr. Beazley was prominent in Merseyside commercial life.

We record with regret the death of Mr. F. B. FOOTTIT, Secretary of the Newark Gas Company, who died last week at the age of 63. He had been Secretary of the Company for 34 years, succeeding his father. He was a solicitor, and among his public duties he was also Borough and County Coroner. A keen sportsman, he hunted regularly with the Blankney and other local packs, and was President of the Newark Rowing Club and Vice-President of the Newark Tennis Club. Mr. Footttit was buried in the family vault in the Newark Parish Churchyard.

With sorrow, we announce the untimely death of Mr. JOSEPH CUFFLING, the Secretary of the Yorktown and Blackwater Gas and Electric Lighting Company. He was knocked down by a motor while cycling to his house, and died from the injuries received. The late Mr. Cuffling had been Secretary to the Company for eight years, previous to which he was Chief Collector. He was very highly respected in the district. Prior to joining the staff of the Company, he served in the Royal Artillery, becoming a Staff Sgt.-Major, and finally Sgt.-Major at the Staff College, Camberley.

Those in the gas industry, and, indeed, all who came in contact with Mr. STEPHEN TEMBLETT, will receive the news of his death, which occurred on Aug. 2, at Andover, with a feeling of deep regret. Mr. Temblett, who was 64 years of age, was a Somerset man, and went to Andover in 1899, as Manager of the Andover Lighting and Power Company, a position he held with distinction up to the time of his death. During his 35 years in the managerial capacity he practically rebuilt the works, and the output increased by almost five times. Prior to his appointment at Andover, he was for eight years Manager of the Whitchurch (Hants) Gas Company. Deceased was one of the early members of the Southern District Association of Gas Engineers and Managers, and also of the old Institute (now the Institution) of Gas Engineers. The fullest sympathy is extended to his daughter and to his son, who, as Secretary and Assistant Manager of the Andover Lighting and Power Company, has been actively associated with his father for the past twenty years.

It is with deep regret that we record the death, which took place at East Molesey, on Sunday, Aug. 3, of Mr. ALFRED GOODMAN, Chairman of the Hampton Court Gas Company. His connection with the Company covers a period of 46 years. He joined the Board of Directors in 1878; in 1901 he was elected Deputy Chairman, and in 1909, on the retirement of Mr. R. J. Kent, he succeeded to the chairmanship, a position which he held up to the time of his death. He did much to promote the interests of the gas industry, and took an active part in the public life of the locality in which he resided. By profession a solicitor, Mr. Goodman was a member of the old Molesey Local Board, and subsequently of the District Council; his membership of these bodies extending over nineteen years. The funeral service, at the East Molesey Parish Church on Thursday last, was attended by many well-known residents of Molesey and the following Directors and officials of the Gas Company: Messrs. H. Pullman, J.P., C. W. Kent, F. Packham, A. Wood; W. E. Price (Managing Director), W. C. Lamb (Secretary), C. T. Price (Manager), F. S. Sloman (Auditor), and H. P. Gloyns (Collector).

ELECTRICITY SUPPLY MEMORANDA.

THERE is ample evidence in every district where electric cookers have been installed as to the inefficiency of the boiling-plates. Gas undertakings know of this, because they are so often called in to provide the only sane relief for the distressed but enlightened user. The confirmation that is obtained in the electrical papers is not news to gas men; nevertheless there is interest in it. We have heard a great deal about the progress of electric cooking in Newcastle-upon-Tyne. But Newcastle is no exception to the rule in respect of dissatisfaction. "Cuisinier," writing from that city, states that a short time ago, being disgusted with the boiling-rings of his own electric cooker, he made inquiries among his friends and found that, of seven who had installed cookers, there was only one who would not gladly change back to gas, could this be done without further expense or trouble. We are not aware if any of these were electrical people; but we have known of the wives of electrical men who have insisted upon a reversion from electricity to gas for culinary and water-heating operations. There is a case where an electrical man got rather unpopular in his own family through insisting on the retention of the electrical apparatus. However, "Cuisinier" declares that in every case to which he refers the slowness of the hotplates was given as the reason for discontent. The one satisfied user had a self-contained kettle for boiling water. Of the six dissatisfied ones, four used only the oven and grill; gas-rings being employed for all boiling, frying, &c. Experience by consumers leads to recommendation, favourable or otherwise, among friends. The same writer has come across four people who would have installed electric cookers but for the fact that they were strongly advised not to do so by friends who had them already. It is also acknowledged that approximately 80 p.ct. of the cooking in the ordinary household is done on the boiling-plates; and therefore users are largely influenced by the working efficiency of that most actively employed part. Electrical advocates would rather this were not so.

Boiling-Plate Inefficiency.

Even in the much advertised Newcastle area, "Cuisinier" is able positively to write: "Electric cooking is certainly falling into grave disfavour in this district." In his opinion, no cooker should be hired out without an electric kettle. But kettles are not the only articles used for boiling and frying. All the cookers in question, it is stated, are of a well-known make, and are fitted with 1·3 KW.-hour open hotplates, in which the elements are 1 to 1½ in. below the utensil. They take sixteen to seventeen minutes to boil 2 pints in an ordinary aluminium kettle, as against eleven minutes in an electric kettle of half the loading. Notwithstanding all this, "Cuisinier" is optimistic. He believes that supply engineers must hire out cookers of the latest and best designs, accompanied by a self-contained electric kettle. If this is done, "nothing can prevent electric cooking becoming the only method worthy of consideration." We do not agree. If a kettle must be supplied, why not a whole series of self-contained saucepans for the many and varied operations of the kitchen? Hire rates are pretty steep now; and such provision would, of course, make them prohibitive. Though prohibitive, high rates are apparently necessary for the business to be financially sound. Anyway, it is sincerely avowed that the electric cooker needs propping-up by a self-contained electric kettle.

The Electric Kettle Prop.

The electrical people acknowledge the uneconomies and deficiencies of electric cooking by their persistent endeavours to find new ways of performing various operations in order to lower money and time expenditure. Advocacy is now being made of the process of "frittering;" and the dispenser of "Cooking and Heating Notes" in the "Electrical Times" manifestly thinks highly of it. He describes the process as consisting of raising fat in a deep utensil to a high temperature—in one place described as 300° to 350° Fahr., and in another 400° to 450° Fahr.—and then completely and suddenly immersing in it the food to be cooked. Both current and time, it is said, are saved by the process. For it the same claims are made as for the electric oven, that the surface of meat is sealed instantaneously, and that the "natural" juices are retained. It cannot be imagined that in any circumstances unnatural juices would be retained. It is somewhat strange that the surface is "sealed" by hot liquid. It is also asserted that the fat can be used for all sorts of purposes. You can cook a chop, bloater, or onions without the flavour of one being transmitted to the other. Common sense suggests that the fat would need frequent changing, as it must get more or less polluted by different foods being placed in it. The cost of the fat should be added to that of the current. What of the gravy, too? We like a little gravy with our meat and vegetables. Is this lost? Another point—we should not continuously like food that had been cooked in a surround of fat. However, it is explained that the fat or oil is in a bowl-shaped container (having a curved lip), into which fits a cylindrical body holding the heating elements. The elements conform to the shape of the bowl; and to this feature (which ensures the greatest

Fritter and Economize.

proportion of the heat developed being radiated directly on to the underside of the oil-dish) the efficient operation of the appliance is largely due. Further, we read, heat losses are kept low by lining with asbestos sheeting the cylindrical body which supports the cooking dish, and packing the underside of the heating elements with slag wool. The adaptation of electric heating to the "frittering" process is due to Messrs. Quickways, Ltd. We are sorry, but we do not particularly fancy this mode of cooking, unless just by way of a change.

New Custom and Lower Averages.

When a public utility undertaking is fairly well developed, and has reached saturation point so far as likely large custom is concerned, then the average custom per consumer begins to descend. This was at one time so in the gas industry; but the average consumption has in its case been ascending since, owing to the greater diversity of use and more liberal use, which are attributable to the appreciation of the economies and facilities which gas as a fuel provides. In the electricity industry, as the number of smaller consumers increases, so the average consumption per consumer diminishes. An illustration of this is furnished by Southampton, some statistics regarding which have appeared in the "Electrician." These are the figures, which exclude traction and public lighting:

Year.	Number of Consumers.	Sales, Millions of KW.-H.	KW.-H. per Consumer.
1914	3001	4·23	1411
1915	3300	4·62	1398
1916	3623	5·34	1474
1917	3726	5·80	1555
1918	3818	6·35	1664
1919	3930	6·29	1601
1920	4301	6·64	1542
1921	4781	7·26	1518
1922	5333	6·35	1190
1923	6178	7·53	1219
1924	7336	9·37	1278

It will be seen from the foregoing that the peak average was reached in 1918 with 1664 KW.-H. There was a gradual descent in the average to 1190 KW.-H. in 1922, since when there has been a little picking-up to 1278 KW.-H. last year. This figure is 386 KW.-H. below the highest average in 1918, and 133 KW.-H. below the average for 1914.

A Defective Plug.

A plug which was part of an electric apparatus for boiling water was the cause of the death of a little girl (aged four) a few days ago at St. Annes. Elsie Lonsdale was the daughter of a solicitor. With two younger children she was left in a room for a few minutes, when the maids were attracted by screams, and found the child's clothes in flames. It was discovered by an electrician that the wires connecting an electric plug with the service had broken away, and the ends of the wires were burned. It was the view of the expert that if the wires had come in contact, there would have been a flash strong enough to fire the girl's clothing. There seems little doubt as to this having happened.

New Wiring Rules.

Despite the existence of wiring rules, we know there is a great deal of transgression from them; but now that the electricity industry is contemplating a greater rectitude and obedience to rule in the matter of proper wiring, and contractors are being registered who by the act of enrolment pledge themselves to work to the best standards of equipment, much of the poor installation work of the past ought not to be repeated. At the same time, rules and regulations, pledges, and desires within the industry will not prevent the inflow or continued existence of those contractors who are prepared to do shoddy work at low prices attractive for some people. Gas men will do well to assist the electricity industry to keep business away from such contractors by ensuring a good efficiency in gas utilization. This will cause people to have no wish to spend money on electric installations—good or bad. However, the work of revising the wiring rules of the Institution of Electrical Engineers has been completed, after several years of hard work by a large Committee of experts representative of all the interests concerned. The new rules are subscribed to by nearly 500 firms, companies, and organizations—including the Fire Insurance Offices (which is most important), the Incorporated Municipal Electrical Association, and other electrical bodies. To effect agreement between so many institutions, there must have been a great deal of compromise. The danger lurking in the means of electricity utilization is (we gather from an article in the "Electrician") exemplified by one or two points. Rule 100—there are ninety and nine before it—requires, it is stated, that in bath-rooms all exposed metal liable to become "live," such as the covers of switches, shall, in addition to being earthed, be placed out of reach of a person standing in the bath, and that all lampholders in bath-rooms shall have their exposed metal parts efficiently earthed, or, alternatively, all parts liable to be handled when replacing a lamp shall be constructed of insulating material. Rule 103, too, is described as very far-reaching: "All current-consuming devices, whether portable or fixed, with pressures of over 100 volts direct current or 30 volts alternating current, to have all metal liable to be charged, should the insulation become defective, efficiently earthed." Thus every iron, toaster, or portable radiator must be connected by means of the three-pin plug and three-wire flexible cord containing an earthing wire. Another rule provides that in future on every portable desk standard the lampholder, instead of being screwed direct on to the metal work, must be insulated from the fitting, and, further, the lampholder must be so shielded by insulating material that it cannot be touched accidentally by a person replacing the lamp. Perhaps in the interests of confidence in electricity, the industry will think it just as well the public are not made acquainted with these rules.

A Prosecution and Damages.

The Halifax Corporation have been severely censured for high-handed proceedings in connection with the making of a wrong electrical connection. It is not a nice thing for citizens with good reputations to be accused of fraudulent consumption when the circumstances conclusively point to an error. When that is the case, and prosecution occurs, one gets impressed with the idea that malice lurks somewhere. In this instance Mr. George Henry Willson, Managing Director of Messrs. Smith, Barker and Willson, Ltd., engineers, and a fellow Director were prosecuted by the Corporation in connection with the making of an electrical connection. It seems that up to 1922 the Company were customers of the Corporation for electricity; but in that year they installed a generating plant of their own, from which they were able to produce energy at a lower rate than that at which the Corporation could supply them. They merely used the Corporation service as a stand-by; but it was discovered that a cable had been connected by the Company's electrician to the Corporation supply, so that current for lighting and heating was being secured at the power rate. But seeing the Company were generating current at a lower rate, there was obviously no reason or advantage to them in securing supply at the Corporation power rate, nor could the electrician who made the connection derive any advantage from it. When the case was heard, the summons was dismissed. Then the *dénouement*. The Corporation were sued for malicious prosecution; and at the West Riding Assizes, a jury awarded Mr. Willson £300 damages, with costs.

Eliminating Condensation on Outlet Pipes.

The corrosive action of products of combustion on ordinary galvanized flue outlet pipes of gas-furnaces for house heating having proved an objection on the Pacific Coast, internal insulation of the pipe was tried, with instant success. Drawing attention to the matter in the "American Gas Journal," Mr. Charles W. Geiger says it was thought that if the inside of a galvanized outlet pipe were properly insulated to eliminate the heat lost by radiation through the walls of the pipe, the temperature of the exhaust gases would be maintained throughout the length of the pipe, the vapours would be discharged to the atmosphere above the condensation point, and the outlet pipe would last indefinitely. An experimental test was therefore made, using an ordinary galvanized iron pipe lined with a 1-in. wall of heat insulator. The result, as already remarked, was an instant success. This flue pipe is being adopted all along the Pacific Coast. The insulator is composed of millions of small air bubbles imprisoned in a binder. The cellular structure of the material is the result of an effervescent action in a liquid mixture, so timed that it occurs just before the mixture sets. Each air bubble is separated from the others, thus giving an ideal insulator. The latter is cast in the flue pipe, using a core to form the complete mould. The small amount of solid matter in the material consists of calcium sulphate, which is insoluble in water. Furthermore, being a sulphate, it is not affected by the sulphurous acid in the exhaust gas. In addition to eliminating all corrosive action, it improves the draught and minimizes the possibility of smothered flames on first lighting up.

An English Silica Gel Plant.—It is stated that the plant of the Medway Oil Refining Company, the first silica gel plant for oil refining to be completed in England, is in satisfactory and complete operation. Negotiations are said to have been entered into by the Company for another plant of double the capacity of the original one.

North British Association of Gas Managers.—The annual general meeting of the Association will be held in the Institution of Engineers and Shipbuilders, Elmbank Crescent, Glasgow, on Thursday, Sept. 4. The chair will be taken at 10.30 by the President, Mr. John W. M'Lusky, M.I.Mech.E., of Glasgow, who will give an address. After an adjournment for lunch, the William Young Memorial Lecture will be delivered by Dr. A. Parker, of Leeds University, and in the evening there is to be a reception and dance given by the Lord Provost, Magistrates, and Councillors of the Corporation of the City of Glasgow, in the City Chambers. For the following day an excursion has been arranged to the famous Lochs Goil, Long, and Lomond. The annual golf competition for the Challenge Bowl will be played on a Glasgow course on the afternoon of Wednesday, Sept. 3, at 2.30; and for the same day and the same time a bowling competition has been arranged to take place on Titwood Green.

A COMPLIMENT FROM FRANCE.

The "Journals" for June 18 and July 2.

The "GAS JOURNAL" is much indebted to its contemporary, the "Journal des Usines à Gaz," the official organ of the Société Technique, for a gracious tribute which appears in its current number (Aug. 5). We are not a little proud. Certainly we are surprised, and pleasantly, for it is on very rare occasions that a technical paper sees anything to its credit in the columns of a contemporary; and as far as our special numbers are concerned, it seemed the natural thing to publish one dealing largely with *le gaz en France* before the Institution's visit, and thereafter to supply an account of the latter with all speed to the less fortunate ones who could not make the journey.

We shall be forgiven if, largely for record purposes, we extract and translate a portion of the leading article in the above-mentioned number of the "Journal des Usines à Gaz." "We do not wish," they say, "to bring to a close our record of the Centenary Celebrations without devoting a special article to the manner in which the Technical Press of England, and particularly the 'GAS JOURNAL,' brought the matter before their readers." After briefly reviewing the special articles in our June 18 issue, our friends say:

"We cannot too strongly aver to our English colleagues, and more particularly to the 'GAS JOURNAL,' how much we appreciate the spirit of sympathy which characterized these noteworthy articles, to which Mr. Samuel Tagg, President of the Institution of Gas Engineers, specially referred in the toast he proposed at our Official Banquet; and we are happy here to record that this sympathy is fully reciprocated. We renew our thanks for the pleasure which we derived from the visit paid us.

"The number of the 'GAS JOURNAL' for July 2 was also a special one, but devoted this time to the Annual Meeting of the Institution of Gas Engineers. We shall return later to the various features of this Congress, and especially to the technical papers, of which the majority were of considerable current interest. We wish, however, on this occasion to express our heartiest congratulations and most sincere compliments to the outgoing President, Mr. Samuel Tagg, and to his eminent successor, Mr. J. Ferguson Bell.

"From the point of view of journalism, this number of our contemporary excites our admiration, and we feel we must express this to the staff of the 'JOURNAL.' As a matter of fact, whereas our excursion from Paris to Douai and St. Quentin took place on Sunday, June 29, in the next week's issue (received early by our President, M. Rouland) appeared not only the full account of our varied programme, but excellent photographs to illustrate the article; and English humour as usual claiming its place, there were included in a few tart sentences 'post-impressions' of the visit. Finally, the last echoes of our Centenary Celebrations had hardly died away, when in an editorial on July 9 the 'JOURNAL' took up a matter which is very dear to us—that of the relations between English and French gas engineers. This did not deal with what was past, but followed up and emphasized an idea for the future on which Mr. Tagg had touched in his speech at the Banquet; and we feel that no course is open to us but to reproduce *in extenso* the article in question."

The article in our columns, of which a verbatim translation follows, was the editorial on page 243 of the July 9 number, in which was urged the importance of regular international co-operation and even the exchange of personnel between the industries of the two countries.

We repeat our thanks to the "Journal des Usines à Gaz," which is published under the august eye of M. Henri Laurain, Chief Engineer of the Société du Gaz de Paris.

COAL MINERS' WAGES IN THE UNITED STATES.*

The Institute of Economics was established by the Carnegie Corporation of New York for the sole object of ascertaining the facts, without regard to the special interests of any group in the body politic, either political, social, or economic, about current economic problems, and of interpreting these facts for the people of the United States in the most simple and understandable form. It is thus that we have from the pen of Mr. Isador Lubin a clear, unbiased, and very readable account of the mining wages system in force in the United States, when he sets out, under the auspices, and with the aid of the staff and Council, of the Institute, to give to the public an impression of the effect of miners' wages in relation to the cost of coal, and how the system has affected the welfare of all who are concerned in the industry.

Into a few pages of introduction are crowded a wealth of interesting facts and figures, and the English reader is early made to feel quite at home when he learns that "over there" also owners and men blame one another for all troubles and difficulties which beset the industry. The author absolves them both from any large degree of blame for prevailing conditions, though quoting the opinion, without comment, of the Chairman of the United States Coal Commission, that the industry is "the worst conducted, from an engineering point of view, that I have ever seen."

Of the 663,000 men employed in bituminous coal winning, only about 60 p.ct. are members of the United Mine Workers of America—the union with which the wages agreement is negotiated. These trade unionists produce not quite two-thirds of the total output. An interesting chapter gives a very clear description of the mining process in which these men are engaged, and the long-wall and board-and-pillar methods commonly employed appear to resemble very closely our own practice. Seams ranging in thickness up to 20 ft. are described, and, since such exist, it is small wonder that seams less than 30 in. thick are not usually regarded as a commercial proposition, and, incidentally, that American coal can often be put into European ports at prices which cut our own out of competition.

So far the book may be said to be of very general interest, and to give, as concisely as possible, a very clear insight into the coal mining industry in America, which has, since the war, become so important a competitor with ours in the world market. The details of wage arrangements, which are its main consideration, concern chiefly those who are interested in the particular problem. And mining wages, which are hardly comparable with those of other industries, are generally dismissed with a shrug by the average man as being incomprehensible. Comparison of the United States system with our own, moreover, is almost impossible. The basic idea with them is competitive equality. This means that wages are varied by what are known as "differentials" in such a way as to allow those mines which are less favourably situated (and differences are very considerable) as to geographical situation, thickness of seam, mechanical coal-cutters, and in any other way, to compete with more favoured producers. Naturally the miners claim that the owners shall share with them the results of such disabilities. But that they concede such a principle at all, as being the only way of keeping all districts in production, implies a much more reasoning attitude towards the inherent difficulties of the industry than we have grown accustomed to expect on this side.

The owners, it appears, are a long way behind the men in their organization. But with districts scattered over such huge distances as compared with our own, and with seams of such varying thicknesses, district settlements must always continue to play an important part. Above all, that perpetual bone of contention in our own industry, the minimum wage, to which so many of our troubles are ascribed, is absent. All coal hewn is paid for on piece-work rates, and it is hard to see anything which might encourage "ca' canny" work.

The impressions obtained from reading the work are chiefly that the coal industry of the United States is still very much in its infancy compared with our own, and that there is far more realization on the part of the workers of the community of interests that exist between owners and men. The author, in his summing-up from the consumers' point of view, inevitably concludes that it is economically unsound so to adjust wages as to keep in intermittent production those mines which otherwise could not compete. This he bases on the very significant fact that the total productive capacity of the country to-day is more than 200 million tons in excess of what home consumption and export have ever warranted. The wages system, it is maintained, is responsible to a large extent for the over-expansion of the industry which exists to-day. This has brought with it irregularity of operation, excessive costs, and waste of coal resources. It accounts largely for the annual loss of over 30 p.ct. of the miners' possible working time. It necessitates the maintenance of 200,000 surplus men. It adds to the consumers' coal bill some 100 million dollars annually of overhead charges for idle time.

All of this the author discusses from the home consumers' point of view. For us, surely, there is much food for thought as to America's capacity as an ever stronger competitor in the world market.

* "Miners' Wages and the Cost of Coal," by Isador Lubin. Published by the M'Graw-Hill Book Company, Inc., No. 370, Seventh Avenue, New York.

Institution of Public Lighting Engineers and Superintendents.—The dates fixed for the first annual meeting, to be held in Glasgow, are Tuesday and Wednesday, Sept. 16 and 17. On the Tuesday the members and delegates will be officially received by the City Corporation of Glasgow, and entertained to luncheon in the City Chambers. On the same day the President (Mr. S. B. Langlands, J.P.), will give his presidential address. During the meeting, papers will be delivered by Mr. T. Haydn Harrison, M.I.E.E., Mr. E. J. Stewart, M.A., B.Sc., who will speak on "Street Lighting and Visibility," and Mr. R. B. Mitchell, M.I.E.E., whose subject will be "Electric Mains for Street Lighting." The Corporation of the City of Edinburgh have decided to welcome the members of the Institution to Edinburgh, and to entertain them to luncheon in the City Hall on the occasion of their visit there on Thursday, Sept. 18. Arrangements have been made for inspecting the different methods of public lighting in the city.

INTERESTING RECONSTRUCTION OF A GASHOLDER.

At the Isle of Thanet Gas Company's Works.

Some very interesting gasholder reconstructions have recently been carried out at the Margate Gas-Works by Messrs. Samuel Cutler and Sons, Ltd., under the capable direction of Mr. J. M. Campbell, the Company's Engineer and General Manager, whose carefully considered scheme was prepared a few years ago, and has now been satisfactorily completed. Storage at Margate has been a serious question for many years, owing to the heavy seasonal demands and a considerable proportion of the daily output being consumed over certain restricted periods.

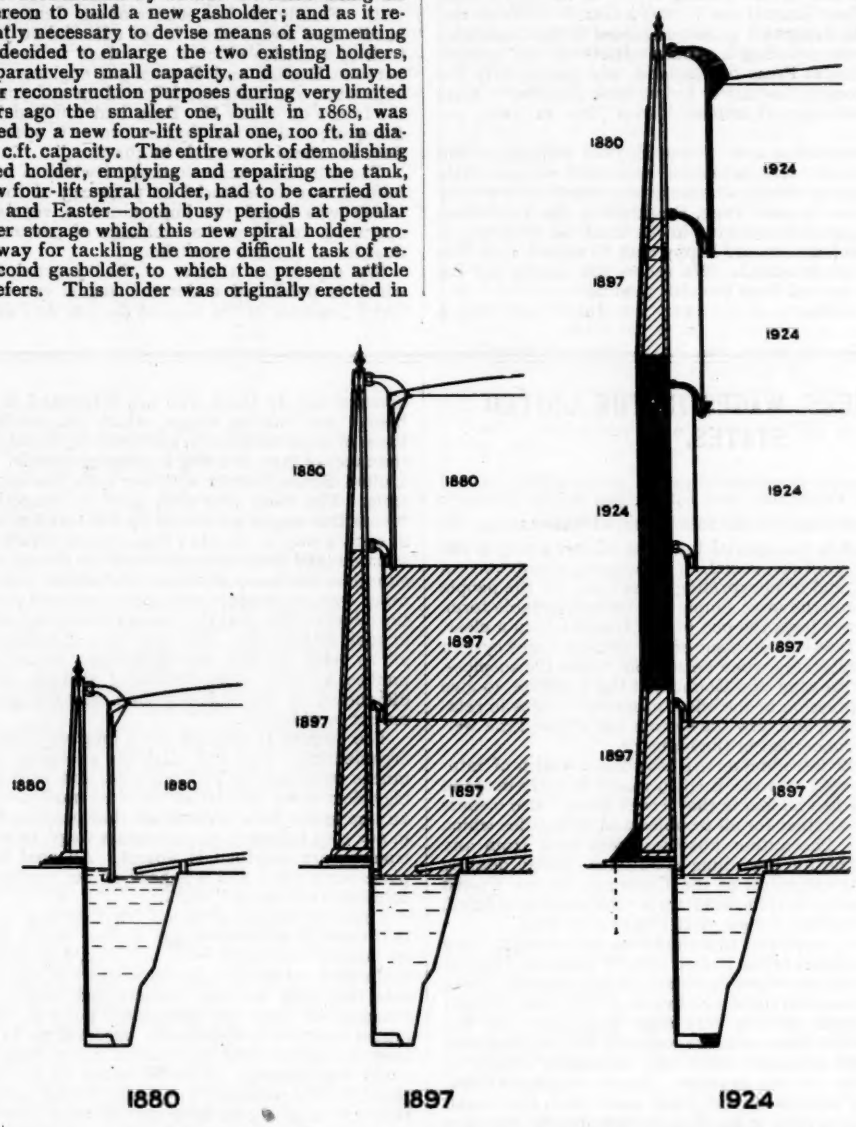
The difficulty was accentuated by reason of there being no available space whereon to build a new gasholder; and as it recently became urgently necessary to devise means of augmenting the storage, it was decided to enlarge the two existing holders, which were of comparatively small capacity, and could only be put out of service for reconstruction purposes during very limited periods. Two years ago the smaller one, built in 1868, was removed and replaced by a new four-lift spiral one, 100 ft. in diameter and of 530,000 c.ft. capacity. The entire work of demolishing the old guide-framed holder, emptying and repairing the tank, and erecting the new four-lift spiral holder, had to be carried out between Christmas and Easter—both busy periods at popular Margate. The larger storage which this new spiral holder provided prepared the way for tackling the more difficult task of reconstructing the second gasholder, to which the present article more particularly refers. This holder was originally erected in 1880 as a single lift, but with provision in the tank for two additional lifts, which were added in 1897. The tank is a brick one, 112½ft. in diameter and 21 ft. deep, constructed in annular form, and with timber framing to support the untrussed crown of the holder.

Local conditions made it inadvisable to empty the water from the tank, which considerably increased the difficulty of rapid reconstruction. The problem that had to be faced was to convert this three-lift gasholder into a five-lift one, re-using all the old guide frame and the 1897 floating parts, but discarding the 1880 parts of the holder, which had seen 44 years' service; and in addition, to increase the seal in the cups of the two re-used lifts, so as to compensate for the greater pressure thrown by the five-lift holder. The whole had to be carried out between Christmas and Whitsuntide.

As before stated, the tank is annular, and as the inner wall was built with a steep batter, steps had to be taken to ascertain whether the bottom of the annulus was of sufficient width to accommodate five lifts instead of three. The spaces were measured at landing-stone level, while the tank was full and the holder at work, by means of synchronized levers, one submerged and the other visible; and it was ascertained that the new inner lift would too nearly approach the sloping wall of the annulus if allowed to descend to landing-stone level. To overcome this difficulty, it was decided to make the inner lift 12 in. less in depth, and land it upon steel brackets bolted to the vertical stays of the second lift—a plan which has answered admirably, and overcome what at first seemed an insuperable obstacle to the provision of a fifth lift.

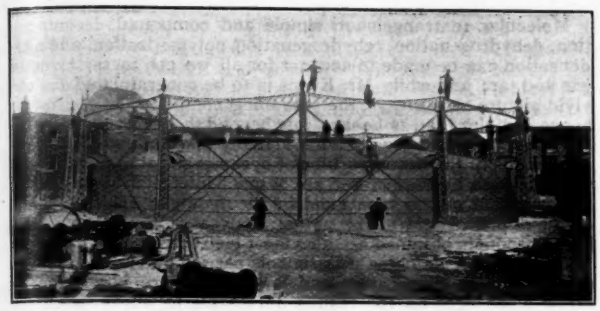
Guide-Framing Reconstruction.

The method of reconstructing the guide frame is shown by the three illustrations marked 1880, 1897, and 1924, from which it will be seen that all existing parts were re-used, but strengthened and re-arranged to suit their new positions. The lower lengths of the standards (fourteen in number) were strengthened *in situ* by the addition of a joist on the back flange and a channel on the front flange, while the bases were also extended and provided with additional anchorage bolts. The new intermediate lengths of standard were erected by a derrick working on the crown of the landed gasholder, and the re-conditioned upper lengths by shear legs mounted upon a travelling carriage revolving upon the partially inflated holder, which was kept level by means of a corresponding counterbalance diametrically opposite to the lifting gear. All existing girders and diagonal ties were re-conditioned and re-used, but supplemented with additional ones, where necessary by reason of the extended framing. The restricted site and close proximity of buildings and public roads prevented the use of external shear legs, and much of the guide-framing erection had consequently to be deferred until the gasholder bells could be air inflated and used for derricking.



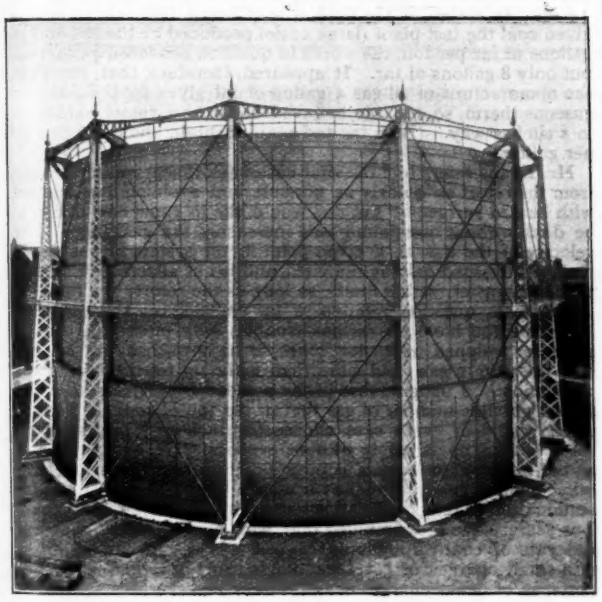
Special Tackle Used.

To carry out this complex reconstruction in the short time at disposal, it was necessary to have every item of material and tackle ready in exact and immediate sequence, and carefully to chart the time required for each section or operation. Some matters could not, however, be foreseen; and after the old 1880 gasholder bell had been removed from the tank, and divers had cleared away the accumulated debris, it was found that the land-



Single-Lift Gasholder as Originally erected in 1880.

ing stones could not be satisfactorily extended in concrete, as at first contemplated. The decision was then taken to make the extension in steel, and fourteen new sets were quickly prepared, lowered into position, and fixed and levelled by divers. These steel extensions embraced the existing stones, and were provided with centering and adjusting gear to facilitate the work of the divers in fixing them. As it was considered desirable to suspend dismantling and erection during the time the divers were at work, these under-water operations necessarily somewhat retarded progress in other directions; but by the use of a special time-saving tackle in the erection of the holder lifts, these were quickly got into position. The tank, being annular, made it possible to use this special tackle with much advantage. It consisted of radial girders extending from the guide frame to trestles placed upon



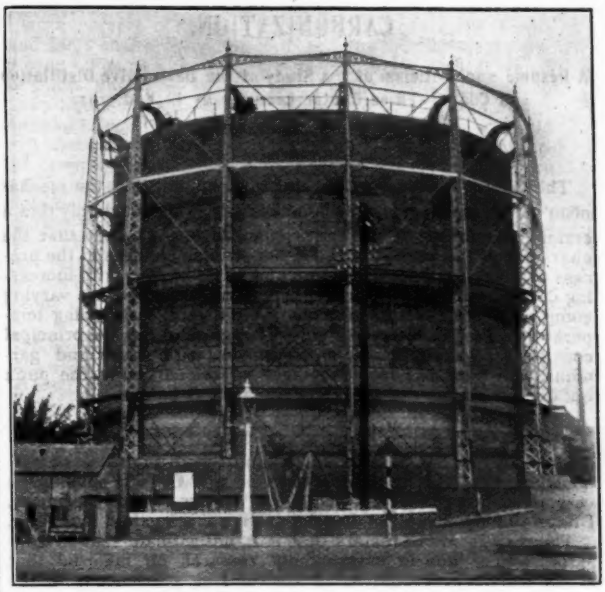
Two Additional Lifts added in 1897.

the dumpling of the tank, and runways supported from these girders upon which were mounted travelling carriages fitted with ball bearings. The materials could therefore be readily lifted and transported to any required position over the annulus.

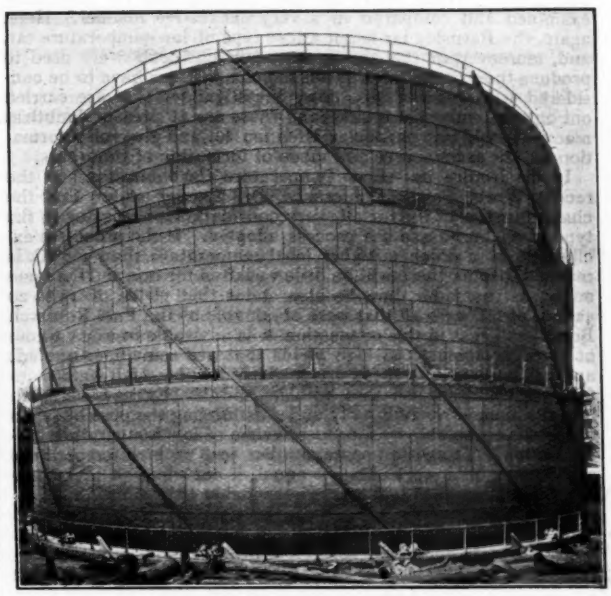
A Quick Job at a Low Cost.

The gasholder was only released from service in January, and notwithstanding the interposition of the considerable unforeseen diving operations, and the handicap of continuously unfavourable weather up to the beginning of May, the reconstructed holder was completed, tested, and put into commission in time for the summer season's requirements. The Company may well be congratulated upon the achievements of their Engineer and the Contractors, as these important gasholder reconstructions and enlargements have been carried out at an unusually low cost, due to the skill with which the re-use of existing tanks and materials has been effected. Not many engineers would have cared to be left with a storage only equal to three hours' recorded maximum output, which was the state of affairs during the reconstruction of the second holder, as the one available holder only has a capacity of 530,000 c.ft., and the quantity of gas sent out from 11 to 2 on one Sunday last summer was 539,000 c ft.

The delivering capacity of the five-lift holder recently completed is 840,000 c.ft., and thus storage is now raised to the relatively comfortable total of 1,370,000 c.ft.—as against the maximum capacity three years ago of only 800,000 c.ft.—with a maximum output of practically 1,750,000 c.ft. a day. For the fact that this ingenious scheme has been successfully accomplished much credit is due to the contractors (Messrs. Saml. Cutler & Sons, Ltd.) for the expeditious manner in which the several



Reconstructed as a Five-Lift Holder in 1924.



Four-Lift Spiral Holder erected in 1923 to Replace the 1868 Holder.

steps have been undertaken; and the Company must feel gratified at the foresight shown by their Engineer in having the enlargements carried out during these recent years. It is perfectly clear that any delay would have prevented their being carried out, as, owing to increasing periodical demands year by year, it would have been impossible to meet them with only one small holder available—thus indicating the far-seeing character of the policy and scheme outlined originally by Mr. Campbell and now carried to successful completion.

The Fireclay Industry.—The importance of a closer application of science to industry is gradually becoming recognized. At a meeting of the Stourbridge Higher Education Committee, it was reported that consideration had been given to a proposal that the Worcestershire and Staffordshire authorities should co-operate in the formation of classes for clay workers and glass workers at Stourbridge and Lye respectively, and that arrangements had been made with the Staffordshire County Council for Dr. H. B. Cronshaw (Principal of the Brierley Hill Institute) to give lectures. In the Stourbridge fireclay area there are eleven clay works in the district of Gornal, twelve in that of Brierley Hill, and ten around Lye and Wollescote. There are about 2500 clay workers employed in South Staffordshire and North Worcestershire. Interest in the scheme is to be stimulated by an association of members and employees of the trade; and the prospects of forming a strong organization are considered excellent. The movement in its initial stage will be restricted to scientific and practical work on refractories.

CARBONIZATION.

A Résumé and Criticism of "A Study of the Destructive Distillation of Coal"—Three Cantor Lectures by E. V. Evans.

By Dr. W. B. DAVIDSON.

(*Concluded from p.* 516.)

The Cantor lecturer was careful to point out that the mechanism of tar cracking is very complicated. It is not simply that a certain proportion of the tar is changed into gas, but that the character of the whole tar undergoes striking changes in the process of cracking, becoming more and more viscous with increasing decomposition. An instructive diagram showed the varying composition of the tars obtained at different carbonizing temperatures from 500° to 800° C., with regard to the five principal constituents—acids, bases, unsaturateds, naphthenes and paraffins, and pitch. The percentages of free carbon in the pitch obtained from the various tars were given as follows—

500° C.	600°	700°	800°
8·6	12·6	16·5	36·1

The first figure, 8·6, to my mind, misrepresents the result of carbonizing at a true low temperature of 500° C. The amount is very much less as a rule—that is, if the tar is really primary. I have already suggested that the carbonizing method is at fault.

This brings me to remark that it is unfortunate that investigators waste time in carrying out research on material that is not truly representative. I am thinking particularly of the important coal-tar researches of K. B. Edwards, recently published ("J.S.C.I.," 143T and 149T, May 9 and 16, 1924), where Barnsley "Coalite" tar, Maclaurin low-temperature tar, Dundee continuous vertical retort tar, and blast-furnace tar have been examined and compared in a very exhaustive manner. Here, again, the Barnsley tar is not a true type of low-temperature tar, and, moreover, in the above case, different coals were used to produce the various tars. Thus the comparisons have to be considered with reservations. Any investigations that are carried out on low-temperature tars—and these are at present doubtless many—should pay particular attention to, and give full information on, the exact source and mode of formation of those tars.

In his lecture on "Low-Temperature Carbonization," at the recent World Power Conference, Dr. Lander states that the characteristics of the tar oils vary considerably, according to the type of coal used and the process adopted. If the processes exclude those in which a higher local temperature than 500° C. is reached, I think there will be little variation for one and the same coal. At the same time, he also states that yields of 13 to 20 gallons of tar were all that were obtainable by the Fuel Research Board, and that in this connection it is advisable to issue a note of warning against the high yields that are sometimes quoted; and he suggests that these are measured with a high water content. I would suggest that both he and Mr. Evans have fallen into the same error of greatly under-estimating the possible yield of tar oils obtainable by a proper system of low-temperature carbonization. The writer contends that just as high-temperature carbonizing on a works-scale is equal, if not superior, to laboratory testing, so also it is not unreasonable to assume that low-temperature processes are, or can be, devised to give the maximum yields of tar obtainable under the best laboratory conditions. A yield, including spirit, not of 15 gallons per ton suggested by Dr. Lander, but of nearly double that figure, is what we may look forward to, and aim at getting, from gas coals when we know more of the best practical working than we generally know at present.

COMPOSITION AND DECOMPOSITION OF PRIMARY TAR.

A great deal of research work has already been done in investigating the composition, synthesis, and cracking of primary tar. Much of it is confused and contradictory—no doubt partly on account of the analytical difficulties of identifying rather complex organic compounds, and partly because of the mixed uncertain nature of the samples put under examination.

Mr. Evans, as more or less warranted by the results of very interesting researches not yet concluded, sketches an attractive picture of the chemical mechanism of tar cracking. He starts out with cyclohexane, C_6H_{12}, one of the constituents of low-temperature tar of which he has made a special study. Chemical reactions are supposed to proceed briefly as follows: Cyclohexane in part undergoes molecular rearrangement with the formation of normal hexylene, and in part splits-off hydrogen to form cyclohexene, C_6H_{10}. The former may give rise successively to amylene, butylene, propylene, and ethylene, as indicated by Prof. Bone; and the latter (cyclohexene) may produce hexadiene, butadiene, acetylene, or, finally, carbon and hydrogen. Polymerization and condensation of the unsaturated molecules are also called into play, and may result in the formation of aromatic compounds and high-boiling unsaturated bodies. Thus, it is conceived that hexadiene and butadiene may unite to form tetrahydrophenylbutylene, which is then dehydrogenated to give phenylbutylene, which, in its turn, is known to be capable of reduction to naphthalene with elimination of hydrogen. The olefines, again, may be hydrogenated to form paraffins, which, in their turn, may undergo a reverse reaction with the production of methane, together with a lower olefine—and so on, as long as there is any heavy tar vapour left to crack.

Molecular rearrangement, simple and compound decomposition, dehydrogenation, rehydrogenation, polymerization, and condensation can be made to account for all we get in the form of gas and tar; and while Mr. Evans is to be congratulated on the vivid picture he portrays, the prevailing conditions in the retort are so complex that, as he says, it is beyond the wit of man to give anything like a true idea of what actually takes place. The definite results of the decomposition of cyclohexane at 650°, 700°, and 750° C., given by the lecturer, are of much interest in showing that hydrocarbons of this type must be the main gas-yielding constituents of primary tar. The actual analyses of the gaseous and liquid products obtained are also most instructive.

Two series of cracking experiments carried out in the laboratory with high-temperature and low-temperature tars serve to throw some light on the results obtainable in works practice. For these experiments, 10 grammes of tar were vaporized in a stream of coal gas or nitrogen, and the mixture of vapours passed over coke heated to the required temperature. The temperatures selected were 600°, 700°, 800°, 900°, and 1000° C. With high-temperature tar the efficiency of production of gaseous therms varied from about 4 p.ct. at 600° to 25 p.ct. at 1000°, while with low-temperature tar the yield varied from 20 p.ct. to 38½ p.ct. As might be expected, low-temperature tar lends itself much more readily to cracking, or, as one might call it, to oil-gas manufacture, especially at the lower temperatures. The figures secured are probably far short of those obtainable under large-scale conditions, where up to a point the efficiency is quite high. I think with Mr. Evans that it is a matter of great difficulty properly to imitate on a small scale the best working conditions.

Some ten years ago, the writer drew attention to the remarkable results in thermal gas yield when a Birmingham installation of horizontal retorts, fitted with single ascension pipes, and working with eight-hour charges, surpassed test-plant results by 3 or 4 p.ct. As stated at the time, it was found that, where with a given coal the test plant (large scale) produced 72 therms and 11 gallons of tar per ton, the works in question produced 75 therms, but only 8 gallons of tar. It appeared, therefore, that, just as in the manufacture of oil-gas a gallon of oil gives approximately a gaseous therm, so, too, tar behaved under best retort conditions in a similar way. (Both tar and gas oil contain about 1·6 therms per gallon.)

Mr. Evans refers to "the vital necessity of clearing the rich gas from the retort as quickly as possible, and avoiding long contact with heated surfaces;" but one would like to know how this is to be done without overpulling and increasing the gas yield. The velocity of the gas at a given point in the system of gas-works plant is governed only by the yield, and is not affected by the pull of the exhauster, within limits, so long as the retorts are tight.

The main question relative to tar cracking is: Does it pay? Assuming you have no serious troubles with pitched hydraulic mains or stopped ascension pipes, or high viscosity of the tar, does the gain in gas yield more than make up for the loss in tar production? I imagine that in the present-day striving after the largest possible number of gas therms per ton of coal, the gas engineer would in every case choose to crack-up more tar, if he knew how to do it safely without expense. He would be supported in doing so by the lecturer's dictum that "it is economically sound to gasify as much tar as possible"—this after careful examination of the comparative values of gas and tar of the past four years. We are reminded that, with a given retort chamber and rate of coal throughput, the best gas results are obtained with small charges of correspondingly short duration. The advantages of heavy charges or full retorts, however, are such as to prevent return to the old days of six-hour work, despite the attraction in therm yield. As the lecturer remarks, the tendency will be to make up the difference by increasing the rapidity of heating of the coal charge—in other words, by increasing the retort temperature. If, as he suggests, "the tendency of modern carbonizing practice in horizontal retorts is to reduce the free space to an absolute minimum," we must look for better refractory material and higher temperatures to lead the way to further progress in gas production.

After all is said and done, the wise gas manager will require to see a balance-sheet in order to make sure that the best and most expensive retorts and highest temperatures constitute a real economy in gas manufacture. Two important items of expenditure—maintenance of retort-settings and fuel consumption—loom largely in view. An increase in the former of about 25 p.ct., or in the latter of 10 p.ct., will offset a gain of a therm in gas yield. The writer's experience of best Stettin retort material in intermittent vertical retorts, with fairly high combustion chamber temperatures of 1300° to 1350° C., was not a happy one. The lecturer reminded his audience that he was taking no account of fuel consumption; it is an important omission when the subject of carbonization is being considered. His propositions would possess greater weight and value if they were backed up by large-scale tests in which fuel was measured.

RATE OF CARBONIZATION.

There is a great deal said in these lectures about the speed of destructive distillation of the coal charge, and it has been proved to be a very important consideration. When we reflect on the ordinary laboratory method of determining the volatile matter content of coal (7 minutes' heating in a large bunsen flame), we realize that carbonization can be accomplished in five minutes. This is true of both high and low temperature carbonization, but

only applies to shallow layers or fine division, where contact with the heating medium is intimate. It is interesting to consider the carbonizing feat that would be possible if a plate conveyor carried coal in a ½-in. layer through a horizontal retort heated to (say) 1100° C., assuming good contact as in the Caracristi low-temperature process; the speed of the conveyor being 4 ft. per minute. A retort 20 ft. long and 24 in. wide would carbonize 9½ tons per 24 hours, or about six times as much as is ordinarily done. The mechanical difficulties involved in accomplishing this are probably insurmountable; moreover, the coke would be extremely "soft" in most cases. One therefore hardly expects to see this accomplished.

BRIQUETTED COAL.

We are indebted to Mr. Evans for a fine picture of the physical behaviour of coal under heat treatment. It is clearly shown that low conductivity and the presence of a plastic layer militate greatly against rapidity of carbonization. It is the plasticity of highly bituminous coals that has proved a serious obstacle in the use of vertical retorts for low-temperature coking, and also, in less measure, for high-temperature practice. Weyman's researches of recent years are very illuminating from this point of view. I believe it was Roberts ("JOURNAL," Aug. 24, 1921) who first stated he had successfully used on a working scale the addition of 20 p.ct. or so of coke breeze to a coal of a plastic nature, not only to avoid sticking, but also to increase the rate of carbonization. In the Sutcliffe and E. C. Evans process experimented with by the lecturer, the ground coal and coke breeze are mixed in the proportions of 3 and 1, and briquetted without a binder. As the duration of carbonization is over 30 p.ct. less with the briquetted mixture than with the coal alone, it follows that the actual throughput of coal is appreciably greater.

The thermal model shows up the difference in carbonization very well as regards speed. The most remarkable result obtained is the large increase of about 9 p.ct. in the yield of volatile therms (gas and tar); coal alone giving 90·8, and the briquettes 99·2 per ton of coal. The new process, in spite of efforts to work at higher temperatures, has so far proved to be a tar-conserving one, so that the additional therm yield is discounted in the eyes of the gas manufacturer. At the higher temperature tried, the gas yield was 71·1 therms, as against 74·7 for coal alone; while the respective tar therms were 27·5 and 16·1. I would remark here that the thermal balance is not complete, as we have no figures for the briquette before and after carbonizing, nor for fuel consumption. Briquetting is said to cost 3s. 6d. per ton (presumably of the mixture). Thus there is an obvious deficit in revenue, assuming ordinary returns for the coke made.

That the briquetted coal process appears very promising is indicated by the advantages claimed, which may be briefly enumerated—

1.—Increased volatile therm yield of about 9 p.ct.
2.—Increased output per retort of about 10 p.ct.
3.—Greatly increased yield of tar (about 80 p.ct.).
4.—Greater density, strength, and uniformity of coke.
5.—Range of coals for carbonizing increased.
6.—All coals, however plastic, are rendered suitable for vertical retorts.
7.—The process lends itself specially well to the de-ashing of coal.

There are many points connected with the whole scheme of quality, manufacture, and supply of the new fuel which call for remark and question. Having regard to the crying need for smokeless fuel, it is to be hoped that the process may eventually prove a commercial success.

Mr. Evans' lectures have been rightly termed a classic in carbonizing literature. His valiant efforts to solve the smokeless fuel problem deserve unstinted praise.

INTERNAL COMBUSTION ENGINES.

A Discussion at the First World Power Conference.

One of the sessions of the First World Power Conference at Wembley—it was on the day following the meeting of the Gas and Fuel Section—was devoted to a consideration of the subject of "Internal Combustion Engines," as introduced by a series of nine papers, which dealt with large and small, land and marine, gas and oil engines. One of these papers was that by Prof. F. W. Burstall on "The Gas Engine"—already presented to the Gas and Fuel Section (*ante*, p. 518). The chair was taken by Mr. FREDERICK B. BROWN, M.Sc., American Society of Mechanical Engineers, of Montreal.

LARGE GAS-ENGINES.

Mr. JAMES RICHARDSON, B.Sc., M.Inst.C.E., in a paper, said that for large gas-engines utilizing producer and blast-furnace gas, the great steel and iron works form the chief fields of use, since in these applications very economical results can be obtained. He has learned that the largest double-acting four-cycle gas-engine being built now has four cylinders of 51¼ in. diameter by 59 in. stroke, and develops a total of 8000 B.H.P. at a speed of 94 revolutions per minute. This engine has overhung cranks. Recent improvements in simplification of design, attaining symmetry of parts subject to heat stress, the selection of better materials, improved valve gear, and the use of exhaust-gas boilers make these units attractive propositions. The mean effective pressure originally arranged for in large gas-engines was of the order of 72 to 75 lbs. per sq. in. Later this was increased; but the resulting troubles demanded a reversion to the original pressures. A novel type of large gas-engine, whereby the interposition of a mechanism of rods achieves double action by permitting of the coupling of four single-acting cylinders of relatively small power to a single crank, has been developed; and by means of this construction vertical engines of 3000 B.H.P. are possible.

INTERNAL COMBUSTION TURBINE.

Mr. RICHARDSON concluded by saying that considerable work is being undertaken on the Continent in connection with the internal combustion turbine; but it is doubtful whether, without great strides in thermo-dynamics and metallurgy, it can hope for many years to compete on the score of economy with the reciprocating engine. Any decrease in maintenance costs, due to the rotating motion, supposing the heat stress questions are eliminated, will be more than counterbalanced by the increased fuel consumption.

GERMAN OUTPUT OF LARGE ENGINES

Herr PAUL R. MEYER, of Nürnberg, stated in a paper that the total output of large gas-engines in Germany up to 1923 amounted to 2,600,000 B.H.P., comprising 2,230,000 B.H.P. of the four-cycle type, and 370,000 B.H.P. of the two-cycle type. Of this total, about 2,000,000 B.H.P. have been installed in Germany, and 600,000 B.H.P. in other countries. The capacity of the units ranges between 500 and 8000 B.H.P., though engines of this character of less than 1000 B.H.P. are seldom met with. At one time the mean indicated pressure went up as high as 75 lbs. per sq. in., with a rather high compression; but occasional excessive explosion pressures were found to affect the reliability of the working parts. Therefore, the general tendency of recent years has been to return to a moderate compression and a mean indicated pressure of about 65 lbs. per sq. in.

On still larger units being called for, it was found that even the output of the big four-cycle engine could be considerably increased in a rather simple manner, without submitting the engine to higher stresses than hitherto—*i.e.*, by the scavenging and supercharging process. The burnt gases remaining in the cylinder at the end of the exhaust stroke are scavenged by means of compressed air (3 to 4 lbs. per sq. in.). Towards the end of the following suction stroke, more compressed air is admitted, and mixes with the sucked charge having an excess of gas. The compression space is thereby made useful for the charge, and the temperature of the sucked mixture reduced. Corresponding to the increased weight of the charge, the average indicated pressure rises to 90 lbs. per sq. in. and more, resulting in an increase of the normal output by 20 to 40 p.ct. Working in this way, the largest engine unit with four cylinders has a capacity of about 12,000 B.H.P.

At the present time hardly a gas-engine is installed in Germany without a waste-heat boiler. These are all of the closed tubular boiler type. An economizer built on the same principles is usually arranged above the boiler, and a superheater is provided between the engine and the boiler. The whole plant is constructed in such a manner that any explosions which might occur in the exhaust piping due to unburnt gases have no detrimental effect. The great heat losses by cooling water also called for attention, and two ways have been adopted of dealing with this. With the one method the cooling water is put under so high a pressure that no evaporation can take place in the cooling spaces. In a special collecting boiler the pressure is reduced, and a part of the water, which has a temperature of more than 100° C., evaporates, whereas the rest returns into the cooling circuit after a corresponding quantity of feed water has been added. By this plan of "not cooling," a certain amount of saturated steam is produced. With the second method, evaporation in the cooling spaces is permitted, and provision is only made for a rapid discharge of the steam. The cooling water and the steam bubbles rise and are led into a steam separator above the engine, whence the water flows back to the cooling spaces after the steam has been separated.

In a modern four-cycle engine a heat consumption of 2400 calories per B.H.P.-hour is not exceeded, assuming a load of 70 p.ct. or more. The thermal efficiency of the gas-power plant with waste-heat recovery amounts to 36 p.ct.

FIGURES FROM THE UNITED STATES.

Mr. C. E. LUCKE, Professor of Mechanical Engineering, Columbia University, New York, offered a paper in the course of which he said that the importance of the gas-engine is far greater than its own present-day commercial position, and its study is still worth while as a source of information for later developments of other styles of engines. The very large double-acting tandem twin gas-engines, built in excess of 4000 H.P. per unit, or 1000 H.P. per cylinder, working on blast-furnace gas, are estimated to number 195 in service, of a total horsepower of 513,470. Of these, 115 operate blowing engines and 80 operate electric generators. Only 18 are less than 2000 H.P., 120 from 2000 to 3000 H.P., 20 from 3000 to 4000 H.P., and 37 in excess of 4000 H.P. There are

larger numbers of double-acting gas-engines pumping natural gas, but figures are not available.

EFFECT OF THE NEW HADFIELD STEEL.

Mr. B. POCHOBRADSKY thought that, while the internal combustion turbine is possibly not yet a practical proposition, the new steel which has been introduced by Sir Robert Hadfield—capable of withstanding a very high temperature, and of retaining at that temperature considerable tensile strength, and non-scaling—means for this form of machine a very substantial advance. With this metal higher compression pressures will be possible, because the exhaust temperatures will not have the effect that they have had in the past. Higher compression means higher efficiency. It would be a mistake to say that, because the internal combustion turbine does not equal the efficiency of the reciprocating engine, it is not a commercial proposition. Efficiency is not the only thing by which one has to judge; other matters such as price per brake-horsepower, repairs, and maintenance, probable life, weight, &c., have also to be taken into account. This justified a somewhat more optimistic view of the possibilities of the internal combustion turbine.

Mr. GIBBONS expressed the opinion that the development of the steam turbine and the heavy capital cost of the large gas-engine have militated against the progress of the latter. The question of capital cost must be seriously looked into.

THE HOLZWARTH GAS TURBINE.

Mr. A. H. LYMN said that he had written a paper for the conference, but unfortunately it had been included in another section. The title of this paper was "The Gas-Producer as Applied to Large Scale Power Generation." The reason why he drew attention to the paper now was that it contained some reference to the internal combustion turbine. It not only described to some extent the principles involved in the Holzwarth gas-turbine, but also showed a photograph of a 5000-KW. turbine set actually in existence in Germany, which had been in operation. This showed that the internal combustion turbine does exist. Another photograph reproduced in the paper was of a sectional model showing the construction of the turbine. This model was in his own office, and could be seen by anyone desirous of inspecting it. He first saw this internal combustion turbine in 1911 or 1912 in Germany, and had fairly carefully watched its development since that time. One could only express admiration for the persevering manner in which the inventor had gone to work. The makers were now prepared to sell a 5000 KW. gas-turbine with the usual guarantees of the type given with a steam turbine, which certainly indicated some progress. The running thermal efficiencies had been 18 p ct. with the smaller sizes; while in the case of the 5000-KW. set it was calculated that the figure would be 21 or 22 p.ct. Prof. Stodola had stated in his book that he expected the efficiency of this turbine would ultimately run up to 29 p.ct.

The following account of the Holzwarth gas-turbine is taken from Mr. Lymn's paper: From the exhaust gas chamber, in which rotates the running wheel, the exhaust gases mixed with scavenging air flow through the steam superheater, the boiler, and the feed heater into the atmosphere. Gas or liquid fuel and compressed air are forced into each explosion chamber of the series to a pressure of 40 to 50 lbs. per sq. in. above atmosphere at a temperature of about 200° Fahr. While this mixture is still in eddying motion, it is ignited by means of high-tension ignition plugs.

The combustion of the mixture takes place on the pure explosion principle, the whole mixture being burnt before the nozzle valve is opened. When combustion is complete, a pressure of about 250 lbs. per sq. in. above atmosphere is reached at a temperature of about 2500° Fahr. At the moment of maximum pressure, the nozzle valve is rapidly opened to its full extent by means of the initial explosion pressures, and the expansion period begins. The gases expand through De Laval nozzles to the exhaust pressure of 15 lbs. per sq. in. absolute, and attain at the end of the nozzles a temperature of about 1250° Fahr. They immediately impinge upon the vanes of a two-blade running wheel, and leave by the exhaust pipe connecting with the waste-heat boiler.

This explosion and expansion cycle and impulse to the turbine wheel only last about two-tenths of a second. As soon as expansion is finished, air is scavenged through the explosion chamber, nozzle valve, and nozzles, whereby the remainder of the explosion gases are swept out of the chamber and the ducts leading to the nozzles, all of which are thereby simultaneously cooled. The explosion chambers are operated in rythmical succession, so that the resultant gases impinge consecutively upon the running wheel.

As a matter of fact—although the materials of the turbine nozzles are momentarily subjected to high temperatures—the average temperature is only 750° Fahr. or 400° C.—*i.e.*, no higher than that of the superheated steam used in modern steam turbine practice. Therefore, contrary to general ideas on this subject, the Holzwarth gas-turbine has no more arduous conditions to withstand than many modern steam turbines, so that all fears in regard to durability of material become groundless.

The Accuracy of a Meter.—A residence gas-meter in continuous service for 27 years was, says the "American Gas Journal," recently removed in a Michigan city and tested, and found to be 100 p.ct. accurate.

Will.—The late Mr. Samuel Spencer, who died on May 16, left £19,125, with net personalty £18,897.

LOW-TEMPERATURE CARBONIZATION RESEARCH.

At the Fuel Research Station.

THE Mines Department and the Department of Scientific and Industrial Research have been giving careful attention to the best means of using the national coal resources, or of solving the problem of how best to unlock the heat in coal. A joint statement on the subject has been issued.

In a programme issued in 1917, the Fuel Research Board explained that a more economical use of the coal resources of the country could only be achieved on a large scale by two main lines of research—first, a survey and classification of the coal seams in the various mining districts by means of chemical and physical tests of the different seams conducted in the laboratory; and, secondly, in investigating the technical problems involved in the attempt to replace some 140 million tons of raw coal at present burned every year in its natural state by other and smokeless fuels obtainable from coal by carbonization and gasification. In illustration of the complex nature of this problem, the Board referred to the belief of some electrical experts that the future of British industry would be greatly affected by the cost of supplying electrical power in bulk, and to the suggestion that the cost of producing power from coal would be reduced if it were first subjected to a form of carbonization which would yield not only an easily-burning coke, but also valuable liquid fuels. The Board pointed out that, while those who were best qualified by experience to judge hesitated to prophesy as to the economical success of this proposal, the question ought to be authoritatively answered once for all. The national importance of the question needs no emphasis. To-day the principal sources of power lie beyond our boundaries. Vast resources of water power and of liquid fuel have been tapped in other lands, and other countries are larger producers of coal than we are. The utmost use must be made of the natural resources we possess if we are to recover our prosperity.

By the work carried out in the Fuel Research Station under the distinguished guidance of its first Director, Sir George Beilby, by the first stages of the survey of the coal seams and by the parallel inquiries and experiments made by private enterprise and by independent investigators, our knowledge of the scientific data has been enormously increased in the last seven years. To-day it is evident that the technical problems of carbonizing coal at low temperatures have been solved in all essentials, but that before the process can be safely introduced with a prospect of financial success, further large-scale work—mainly on engineering problems—remains to be done. There have been a number of partially successful solutions. A process may make successful use of types of coal which under present conditions command little more than the price of waste products and produce a smokeless fuel which sells at the price of good raw coal, while the bye-products of the process may command a price which would not be obtainable if the supply were large. It is one thing to evolve a process which may be a commercial success on a relatively small scale, and quite another to apply it universally. Yet it is only by the solution of the problem on a scale of national importance that any ultimate effect on the state of employment and the industrial prosperity of the country can be produced. For this reason, it is held to be of the utmost importance to give every possible stimulus to the development of any process which holds the promise of a solution of the problem on a big scale, and that some authoritative examination of the more promising processes should be undertaken if the support of the investing public is to secured for their development.

The Government, at the instance of the Secretary for Mines and the Research Department, have therefore decided to provide at once for the rapid development of the chemical and physical survey of the coal seams on which our knowledge of the suitability of the various types of coal for different purposes depends, and further to encourage all promising new processes for the carbonization of coal at low temperatures, which have reached the stage of commercial production. On the survey side, the scheme provides for the establishment of further local committees on which the coalowners as well as technical experts are represented. On the engineering side the scheme offers the assistance, at the cost of public funds, of the Fuel Research Station and its staff in the examination of promising processes under conditions which will shortly be made public.

Eastern Counties Gas Managers' Association.—We learn from the Hon. Secretary and Treasurer (Mr. W. H. Mainwaring, of Lincoln) that the autumn meeting of the Association will be held in London on Wednesday, Oct. 8.

The New Finance Act.—Under the new Finance Act there is an alteration in regard to dividend and interest warrants. After Nov. 30 next these must be accompanied by a statement showing (*a*) the gross amount which, after deduction of income-tax, corresponds to the net amount actually paid; (*b*) the rate and amount of income-tax appropriate to this gross amount; and (*c*) the net amount actually paid. If this is not carried out, a company will be liable to a fine of £10 up to a maximum of £100.

ON THERMAL AND CHEMICAL BALANCE-SHEETS.

By Dr. MORRIS W. TRAVERS, F.R.S.

The first step towards the investigation or design of any new process involving the combustion or gasification of fuel is, or should be, the compilation of a thermal and chemical balance-sheet. By this means we are able to assure ourselves that it is at least within the limits of possibility that the process can follow the course laid down for it, that the available energy is sufficient for the work which has to be done, and that the material balances on both sides of the account. In working out a process there are always practical difficulties to be encountered and overcome; but it is at least encouraging if one can do this with the definite knowledge that one is not wasting time in an attempt to do something which arithmetic would have shown to be impossible.

The method which I have indicated is now used by many engineers and chemists, and one is continually coming across papers including thermal balance-sheets for technical processes. Unfortunately, however, each individual writer seems to adopt conventions of his own, so much so that I frequently find that the simplest method of dealing with a paper of particular interest is to extract the data and work out the thermal and chemical balance-sheets for myself. I do not doubt that others treat my papers in the same way; but if this is so, I have then a better reason for raising a discussion on the subject.

I shall first of all deal with the question of units. If we do not make use of absolute units, any decision as to the choice of units becomes merely a matter of convenience, for the Centigrade scale of temperature is no more *scientific* than the Fahrenheit scale, and the use of B.Th.U. does not indicate an unscientific frame of mind. Practically, however, the Centigrade scale of temperature is becoming more widely used in the scientific and technical world than is the Fahrenheit scale, and there is an increasing tendency to base technical data on it. We have to arrive at a decision as to the application of the following sets of units:

Temperature Scale.	Unit of Mass.	Heat Unit.
I. Centigrade . . .	Kilogramme	Kilogramme calorie (K.C.)
II. Centigrade . . .	Pound	Centigrade heat unit (C.H.U.)
III. Centigrade . . .	Pound	British thermal unit (B.Th.U.)
IV. Fahrenheit . . .	Pound	British thermal unit.
V. — . . .	Ton	Therm (100,000 B.Th.U.)

For purposes of commerce, the *ton* and *therm* must remain, and the B.Th.U. will probably survive the conversion of our monetary system to decimal units as a basis for quality. However, gas engineers have probably already noticed that calorimeters are often, and indeed generally, fitted with thermometers divided into Centigrade degrees, and measuring vessels calibrated in litres, so that they actually measure calorific values in kilogramme-calories, and convert the results into B.Th.U. by multiplying by 3·968. Upholders of the British system should look to this. In many works, particularly in those published in America, temperatures are given in degrees Fahrenheit, and thermal values in B.Th.U. In the publication of the Research Committee of the Institution of Gas Engineers, temperatures are given in degrees Centigrade, but the B.Th.U. is adhered to. For the purpose of technical calculations there are, however, certain advantages in using the Centigrade scale and the Centigrade heat unit; for since the numerical values of Centigrade heat units per lb., and kilogramme-calories per kilogramme are identical, a paper in which the data are given in Centigrade degrees and Centigrade heat units is intelligible both to British and to Continental readers. The system is already very widely used in this country and is no novelty. The conversion of C.H.U. per lb. per ° C. into B.Th.U. per lb. per ° C. is effected by multiplying the numerical values in the former by 9/5.

In calculations involving thermal or chemical changes, I always use the pound-mole (L.M) or the kilogramme-mole (K.M.) as the working unit. This is the molecular, or molar, weight, or in the case of solids the atomic weight, expressed as pounds (or kilogrammes). Thus we have, for example:

Substance.	Pound-Mole in Lbs., or Kilo-Mole in Kilos.
Carbon	12·05
Hydrogen	2·016
Oxygen	16·00
Nitrogen	14·01
Carbon dioxide	44·05
Carbon monoxide	28·05
Methane	16·03

Fractions can generally be neglected.

The advantage of using this system is easily explained. Suppose we are considering the action of air and of steam upon 100 lbs., or $100/12 = 8{\cdot}33$ L.M., of carbon. Taking the case of combustion in air first, we have:

(*a*) The *pound* as unit—

Carbon + oxygen = carbon dioxide.

100 lbs. $\frac{100 \times 32}{12}$ lbs. | $\frac{100 \times 44}{12}$ lbs.

or 266·7 lbs. | or 366·7 lbs.

(*b*) The *mole* as unit—

Carbon + oxygen = carbon dioxide.

8·33 L.M. 8·33 L.M. 8·33 L.M.

Considering the action of steam on the carbon in the simplest case:

(*a*) The *pound* as unit—

Carbon + steam = carbon monoxide + hydrogen.

100 lbs. $\frac{100 \times 18}{12}$ lbs. $\frac{100 \times 28}{12}$ lbs. $\frac{100 \times 2}{12}$ lbs.

or 150 lbs. or 233 lbs. or 16·7 lbs.

(*b*) The *mole* as unit—

Carbon + steam = carbon monoxide + hydrogen.

8·33 L.M. 8·33 L.M. 8·33 L.M. 8·33 L.M.

The simplicity of the numerical relationships when molar units are used is too obvious to call for comment.

When one comes to the more complex case in which both CO_2 and CO are formed, the advantage of the *molar* system is even more apparent. Suppose, for instance, the product of gasifying 100 lbs. of carbon contains CO_2 and CO in the ratio of 1 to 10 by volume. The carbon as CO_2 and the carbon as CO must also be in molar proportion 1 to 10, so that we have:

Carbon as CO_2	8·33 × 0·1	=	0·833 L.M.
Carbon as CO	8·33 × 0·9	=	7·497 L.M.
	Total	=	8·330 L.M.

Then—

(*a*) The *pound* as unit—

$C + 2H_2O = CO_2 = 2H_2$

$0{\cdot}833 + 1{\cdot}666 = 0{\cdot}833 + 1{\cdot}666$

(*b*) The *mole* as unit—

$C + H_2O = CO + H_2$

$7{\cdot}497 + 7497 = 7{\cdot}497 + 7{\cdot}397$

Carbon gasified	0·833 + 7·497	= 8·33 L.M.
Carbon dioxide formed		0·833 L.M.
Carbon monoxide formed		7·497 L.M.
Hydrogen formed	1·666 + 7·497	= 9·163 L.M.
Steam decomposed	1·666 + 7·497	= 9·163 L.M.

To find the weight in pounds multiply in each case by the corresponding molecular weight. Thus for $8{\cdot}33 \times 12 = 99{\cdot}96$ (say) 100 lbs., of carbon gasified we require $9{\cdot}136 \times 18 = 164{\cdot}5$ lbs. of steam. It will be noticed that the result is easy to check by simple addition. Of the molar equivalents of the oxides of carbon, each contains one molar equivalent of carbon, so that (a L.M. of $CO_2 + b$ L.M. of CO) cannot contain more than [($a + b$) L.M. of C]. If the sum (a L.M. of $CO_2 + b$ L.M. of CO) is less than [($a + b$) L.M. of C], some carbon must be accounted for as unconsumed. While speaking of the chemical changes, it may be pointed out that it is frequently necessary to deal with volumes rather than with masses, particularly in the case of gases. Molar quantities of different gases occupy slightly different volumes, but, taking an average for the common gases, we find that at 0° C. and under 760 mm. pressure 1 lb. molar equivalent of gas (dry) occupies 358 c.ft. or 385·9 c.ft. at 60° Fahr. (15·5° C.) and 30 in. of mercury pressure, saturated.

We must now consider the general treatment of thermal changes. The operations with which we are mainly concerned are carried out under conditions which enable us to make the simplifying assumption that they take place under a constant pressure of one atmosphere, so that no work is done against external agencies, and we only have to deal with energy in the form of heat and chemical energy. Further, as this is not an essay on the thermodynamics of gas reactions, I shall adopt the terms in common use in the industry, using the terms sensible heat, latent heat, and total available heat in their usual technical sense.

Before going further we have to decide upon a datum temperature as a basis for calculation. Here we have no general agreement as to the procedure; and, indeed, as I have already suggested, a reader is often left to find out for himself what system has been employed. I have always adopted the system commonly used on the Continent, which takes as a basis 0° C. The sensible heat of any system at $t°$ is the quantity of heat which would be lost or gained by the system with its temperature lowered or varied between 0° and $t°$ without chemical change or change of state taking place. If the change, considered by itself, involves loss of heat by the system, the numerical value of the sensible heat has the negative sign; in the reverse case the sign is positive. It is not uncommon practice to adopt the atmospheric temperature, which is taken as 15·5° C. (60° Fahr.) in technical work, and as 18° in scientific papers. There is no real advantage in taking this temperature, for the results of experimental work have always to be corrected; and if this has to be done it is just as well to adopt the temperature to which the values of scientific and technical constants can readily be reduced.

In dealing with thermal changes which do not involve chemical change or change of state, we require only a knowledge of the values of the specific heats of the substances involved. The specific heats are not, however, constant over a wide range of temperatures, and the sensible heat of a substance cannot be calculated from a simple expression such as:

$$M \times S \times (t - t'),$$

in which M is the mass of the substance, S its specific heat, and $(t - t')$ the change of temperature. We must actually take for S a value corresponding to the particular range of temperature involved; and this value is called the *mean interval specific heat* for the particular temperature interval. In actual practice it is also convenient to use molar quantities rather than pounds or kilogrammes; and as our datum temperature is 0° C., the units

which we employ are the *mean interval molar heats*, 0° to t° C. Unfortunately our knowledge of these constants, even for the substances most commonly handled, leaves much to be desired. Of the common gases and vapours, only air, nitrogen, carbon dioxide, and water vapour have been the subject of investigations such as would place the values of the constants beyond reasonable doubt. There is little doubt that in technical calculations we may, without introducing serious error, adopt the values put forward by Holborn, Scheel, and Henning for the interval specific heats of air, carbon dioxide, and steam, and assume that the values given for air apply equally well to nitrogen, oxygen, and carbon monoxide. The constants for hydrogen do not rest on so firm a basis, the values being probably about 2·7 p.ct. lower than those for air; but in ordinary technical calculations the values for air may be used. The data required for technical calculations are set forth in Table I. No accurate information is available regarding the gases which occur in thermal calculations in lesser quantities. The value of the interval molar heat of methane is probably given with fair accuracy by the formula

$$t\,(9{\cdot}1 + 0{\cdot}0006t);$$

but this value only applies to the range of temperature within which methane may be considered as a stable substance. The values for sulphuretted hydrogen, sulphur dioxide, ammonia, &c., present in small quantity per cent., may be taken to be identical with those for carbon dioxide over the corresponding range of temperature.

TABLE I.—*Mean Interval Molar Heats* 0° — t° C.

° C.	Air, N_2, O_2, CO.		H_2.		CO_2.		H_2O.	
	A.	B.	A.	B.	A.	B.	A.	B.
0 to 15·5	107	193	104	187	136	245	127	229
0 ,, 20	139	250	135	243	176	317	163	293
0 ,, 50	348	625	339	610	448	805	410	738
0 ,, 100	700	1,260	680	1,225	930	1,675	825	1,485
0 ,, 200	1,405	2,525	1,365	2,455	1,930	3,575	1,655	2,980
0 ,, 300	2,115	3,805	2,055	3,700	3,010	5,420	2,505	4,510
0 ,, 400	2,825	5,090	2,750	4,950	4,135	7,455	3,375	6,075
0 ,, 500	3,550	6,390	3,450	6,210	5,295	9,530	4,255	7,660
0 ,, 600	4,275	7,690	4,160	7,590	6,480	11,660	5,155	9,280
0 ,, 700	5,005	9,000	4,870	8,770	7,660	13,790	6,070	10,930
0 ,, 800	5,740	10,330	5,585	10,050	8,890	16,000	7,005	12,610
0 ,, 900	6,480	11,670	6,305	11,350	10,115	18,210	7,955	14,320
0 ,, 1000	7,230	13,010	7,035	12,660	11,345	20,420	8,920	16,060
0 ,, 1100	7,980	14,360	7,765	13,890	12,710	22,880	9,900	17,820
0 ,, 1200	8,740	15,730	8,500	15,300	13,875	24,970	10,900	19,620
0 ,, 1300	9,500	17,100	9,245	16,640	15,190	27,340	11,915	20,450
0 ,, 1400	10,270	18,490	9,990	17,980	16,560	29,810	12,950	23,310
0 ,, 1500	11,040	19,870	10,745	19,340	18,000	32,400	14,000	25,200
0 ,, 1600	11,820	21,280	11,500	20,700	19,540	35,170	15,060	27,110

A. Molar heats 0° to t° C. in C.H.U. per lb.-mole, or in K.C. per kilo-mole.
B. Molar heats 0° to t° C. in B.Th.U. per lb.-mole.

To illustrate the use of Table I., we will take a couple of examples:

(*a*) To calculate the sensible heat of 30 lbs. of CO_2 at 800° C.
30 lbs. of CO_2 = 2·5 L.M. CO_2.
Mean interval molar heat CO_2, 0° to 800° C., 8890 C.H.U.
Sensible heat 30 lbs. CO_2 = 2·5 × 8890 = 22,225 C.H.U.

(*b*) We require to know the sensible heat of 100 c.ft. of dry air at 20° C.
100 c.ft. of air at 20° C. 100 × 273/(273 + 20) × 358 = 0·26 L.M.
Mean interval molar heat 0° to 20° C. = 139 C.H.U.
Sensible heat of air 139 × 0·26 = 36 C.H.U.

In the case of certain materials, such as metals, ash, coke, &c., one must employ specific instead of molar heats. Here again the values of the constants depend upon the temperature range involved, and in a few cases only is the variation with temperature known. The sensible heat of coke, per pound, 0° — t°, supposing the material to be hard burned, can be calculated from the formula—

$$t\,(0{\cdot}195 + 0{\cdot}000115\,t) \text{ C.H.U.}$$
$$\text{or } t\,(0{\cdot}251 + 0{\cdot}000207\,t) \text{ B.Th.U.}$$

The variation in the interval specific heats with temperature varies as shown below—

0° to 100° C. . . 0·210 C.H.U. per lb.
0° to 500° C. . . 0·252 ,, ,,
0° to 1000° C. . . 0·310 ,, ,,

Ash is a very indefinite substance, but as it is usually handled in relatively small quantity, error in the treatment of it does not materially affect calculations. The formula

$$t\,(0{\cdot}19 + 0{\cdot}00006\,t)$$

probably represents the sensible heat of ash (per lb.) 0° to t° C. with fair accuracy.

Where chemical change or change of state takes place, we require to know the values of a further set of constants referred to in technical works as latent heats. The values of those constants also vary with temperature, as the following considerations show. Suppose we consider the following hypothetical cycle of operations. We start with molar quantities of oxygen and hydrogen at 0° C., and heat them up to 100° C. The heat absorbed in the process will be (Table 1):

Sensible heat of 1 mole oxygen . . .	— 700 C.H.U.
,, ,, 2 moles hydrogen . .	— 1400 C.H.U.
Total	— 2100 C.H.U.

The gases are then made to combine at 100° C. to form water; and heat is evolved:

$$2H_2 + O_2 \rightarrow 2H_2O + 2Q_{100}$$

The latent heat of formation of water (steam) at 100° = 2 × Q_{100} C.H.U. We will now for the moment suppose that the steam is cooled down to 0° C. without condensing, which may seem absurd, but is an assumption which is of use at the moment. The amount of heat lost by the steam is (Table 1):

Sensible heat of 2 moles steam = 1650 C.H.U.

Last, suppose that the steam were completely decomposed at 0° C. into the original hydrogen and oxygen. Heat would be absorbed in the process, and we may write

$$2H_2 + O_2 \leftarrow 2H_2O + 2Q_0$$

Latent heat of formation (or decomposition) of water (steam) at 0° C. = 2 × Q_0 C.H.U. We have now got back to the point at which we started, so that the sum of the heat change is zero, and

$$2100 + 2Q_{100} + 1650 - 2Q_0 = 0,$$
$$\text{or } Q_{100} - Q_0 = 1050 - 825$$
$$= 225.$$

Writing the reaction for the formation of water,

$$2H_2 + O_2 = 2H_2O + Qt,$$

it is obvious that the value assigned to Qt, must vary with t. I always adopt the value at 0° C., making this temperature the basis for all thermal calculations. As a general rule the difference between the values at 0° and at 20° C. is within the limits of error of the actual experimental determinations themselves.

In most technical operations involving the combustion or gasification of fuel, water does not occur in the liquid form. Thus, when coal gas or paraffin oil is burned, the water passes away in the form of vapour; and it is only as a result of indirect observation that we are aware of the fact that water is formed at all. However, if we adopt the datum point 0° C. as the basis for thermal calculations, it is necessary to assume that steam, as well as other gases, can be cooled to that temperature. This is the reason for making the assumption, at first sight absurd, that steam can be cooled to 0° C. without condensing, as we can then eliminate from our calculations the latent heat of liquefaction of steam.

Where water is the product of a reaction, there are two values of the latent heat of reaction—the gross value, which assumes that the steam is condensed to liquid, and the net value, which assumes that the steam does not condense. It is the net values which are really of importance in industry; but in the ordinary calorimetric process, where steam is condensed, it is the gross values which are actually measured, and the net values can only be obtained from the gross values by calculation based upon a knowledge of the hydrogen content of the fuel. One actually buys fuel on the basis of the gross calorific value, and uses it on the basis of the net calorific value.

In thermal calculations it is usually only the net value which is of any use; but when speaking of gross calorific values it must be pointed out that there is a considerable amount of confusion attached to their use. I cannot find any legal definition of gross calorific value, but it is generally assumed that the steam is condensed at the air temperature. In thermal calculations it is often assumed, in calculating the sensible heat of a gas containing water vapour, that the water vapour is cooled to 100° C. and then condensed; the liquid water and the permanent gas being then cooled to the datum temperature. Finally there is a simpler system, which supposes that the steam can be cooled to 0° C. and, if it is condensed at all, condensation takes place at that temperature. On this basis the gross calorific value of 0° C. is the net calorific value at 0° C. *plus* the latent heat of liquefaction of steam at 0° C.

In Table II. will be found the values of the net latent heats of reaction at 0° C. The corresponding gross values can be calculated by adding to the net values the quantity N × 10,725 C.H.U. where N is the number of molecules of water formed.

TABLE II.—*Molar Latent Heats*, 0° C.

	A.	B.
Steam = *Water*	+ 10,725 − 10 × t°	+ 19,305 − 18 × t°
$2H_2O + O_2$ = H_2O (steam 0° C.) . .	+ 2 × 57,830	+ 2 × 104,095
$C + O_2$ = CO_2	+ 94,760	+ 170,570
$2CO + O_2$ = $2CO_2$	+ 2 × 67,935	+ 2 × 122,285
$2C + O_2$ = 2CO	+ 2 × 26,830	+ 2 × 48,295
$C + CO_2$ = 2CO	− 41,100	− 73,980
$H_2 + CO_2$ = $CO + H_2O$	− 10,105	− 18,190
$C + H_2O$ = $CO + H_2$	− 31,000	− 55,800
$C + 2H_2O$ = $CO_2 + 2H_2$	− 20,900	− 37,620
$C + 2H_2$ = CH_4	+ 20,360	+ 36,650
$2C + 2H_2$ = C_2H_4	− 38,420	− 69,155
$2C + 3H_2$ = C_2H_6	+ 24,000	+ 43,200
$CH_4 + 2O_2$ = $CO_2 + 2H_2O$ (steam) .	+ 190,060	+ 342,120
$CO + 3H_2$ = $CH_4 + H_2O$	+ 51,365	+ 92,455
$2CO + 2H_2$ = $CH_4 + CO_2$	+ 61,470	+ 110,630

A. C.H.U. per lb.-mole or K.L. per kilo-mole.
B. B.Th.U. per lb.-mole.

Another matter must now be referred to. In common practice the heat of combustion of carbon is taken as the heat of combustion of charcoal, though why this is done I do not know. Charcoal is an amorphous and very indefinite form of carbon, and if it is heated to above 1000° C., it becomes changed into a form of carbon resembling graphite, which is crystalline. This change involves a considerable change in the heat of combustion. The figures in Table II. are based upon the heat of combustion of graphitic carbon, which is a definite form of carbon, and which most closely resembles the form of carbon which exists in coke.

We will now take as an example the case of the combustion of coke in a furnace. The coke is supposed to contain 84 p.ct. of carbon and 16 p.ct. of ash, with no moisture or volatile matter, and is fed into the furnace at 20° C. Primary and secondary air (supposed to be dry), to the extent of 20 p.ct. above that actually required for complete combustion of the carbon, also enter the furnace at 20° C. The ashes, taken as free from carbon, are removed at 300° C., and the waste gas leaves the furnace at 800° C. We can now calculate the amount of heat available in the furnace, including loss by radiation, &c. We shall require the following data:

Sensible heat of coke (per lb.) . . .	$t(0{\cdot}195 + 0{\cdot}000115)t$	C.H.U.
Molar sensible heat of permanent gases	0° to 20° C. (TableI.) 139	,,
,, ,, ,, ,, .	0° to 800° C. 5,740	,,
,, ,, ,, CO_2 .	0° to 800° C. 8,890	,,
Molar heat of combustion of carbon to CO_2.	94,760	,,

Suppose we consider the process to be carried out with 100 lbs. of coke containing 84 lbs., or 7 L.M., of carbon. On combustion:

$$\begin{array}{rcrcrl} C & + & O_2 & = & CO_2 & + \ 94{,}760 \text{ C.H.U.} \\ 7 \text{ L.M.} & + & 7 \text{ L.M.} & = & 7 \text{ L.M.} & + \ 7 \times 94{,}760 \text{ C.H.U.} \end{array}$$

The quantity of air required is therefore

$$\left[\frac{7 \times 100}{21} + 20 \text{ p.ct.}\right] = \left[\frac{100}{3} \times \frac{6}{5}\right] = 40 \text{ L.M.}$$

Quantity converted into CO_2 . . . . . = 7 L.M.

Balance $O_2 + N_2$ in waste gases . . . . = 33 L.M.
CO_2 ,, ... = 7 L.M.

We can now construct a thermal balance-sheet:

Credit—		
Sensible heat of coke 0° to 20° = 100 × 0·197 × 20 =	394	C.H.U.
,, ,, ,, air 0° to 20° = 40 × 139. . . . =	556	,,
Heat of combustion of carbon = 94,760 × 7 . . . =	663,320	,,
Total	662,270	,,
Debit—		
Sensible heat of O_2 and N_2 0° to 800° C. = 33 × 5740 =	189,420	C.H.U.
,, ,, ,, CO_2 0° to 800° C. = 7 × 8890 . . =	62,230	,,
,, ,, ,, ashes 0° to 300° C. = 15 × 300 × 0·2 =	900	,,
	252,550	,,
Heat available in furnaces, and losses	416,724	,,
Total	669,274	,,

Though we can usually consider that water vapour leaves the system without being condensed, we have frequently to deal with cases in which the fuel is wet. Suppose that in the case of the coke in the last example the material fed into the furnace contains 8 p.ct. of moisture. Then for each 100 lbs. of dry coke we have to deal with 8·7 lbs., or 0·725 L.M., of water. The water brings into the system sensible heat measured by the product of the numerical values of its temperature, the quantity of water (in L.M.), and the molar heat of water, which can be taken as 18 C.H.U. per degree. Since the water has to be evaporated, we have to consider the latent heat of evaporation of water; and supposing this change to take place at the zero point, we make use of the constant for 0° C. This quantity appears on the debit side of the balance-sheet, as does the quantity of heat carried out of the system by the water vapour in the waste gas. We have then:

Credit—		
Sensible heat of coke 0° to 20° = 100 × 0·197 × 20 =	394	C.H.U.
,, ,, ,, coke 0° to 20° = 40 × 139 . . . =	5,556	,,
,, ,, ,, water 0° to 20° = 0·725 × 18 × 20 =	260	,,
Heat combustion of coke = 7 × 94,760 . . . . =	663,320	,,
Total	669,530	,,
Debit—		
Sensible heat of O_2 and N_2, 0° to 800° = 33 × 5740. =	189,420	C.H.U.
,, ,, ,, CO_2, 0° to 800° = 7 × 8890 . . . =	62,230	,,
,, ,, ,, H_2O, 0° to 800° = 0·725 × 7005 . =	5,080	,,
,, ,, ,, ashes, 0° to 300° = 15 × 0·2 × 300 =	900	,,
Latent heat of steam, 0° = 0·725 × 10,725 . . . =	7,775	,,
Total	265,405	,,
Heat available in furnaces, and losses . . . . . =	404,125	,,
	669,530	,,

In considering thermal balance-sheets a difficulty always arises in dealing with tar and volatile hydrocarbons. Many writers get over the difficulty by ignoring the formation of tar altogether, and in connection with such problems as the formation of producer gas by the action of air and steam on bituminous coal assume that the carbon is gasified as the oxides, with some methane. In actual fact, about 6 p.ct. of the carbon is gasified as hydrocarbon material of high boiling-point.

The latent heat of gasification of hydrocarbons is certainly low, the values being lowest for the higher boiling fractions. Various authorities give values varying between 85 C.H.U., or 150 B.Th.U., and 55 C.H.U., or 100 B.Th.U., per pound, but the data upon which they rest are of doubtful worth. The difficulty in dealing with the problem is enhanced by the fact that gases from bituminous fuels contain much tarry matter in the form of tar fog, the hydrocarbon material being largely liquid. This being the case, a low value should be adopted for the latent heat.

It is even more difficult to estimate the sensible heat of hydrocarbon vapours. The molar heats of some common hydrocarbons are found to be approximately:

Methane	CH_4	9
Ethylene	C_2H_4	10
Ethane	C_2H_6	12
Benzene	C_6H_6	22
Hydrocarbon?	$C_{10}H_{16}$	22

This illustrates the fact that the molar heats increase only slowly with increase in the molar weights. An estimate of the sensible heat of hydrocarbon vapours demands then a certain knowledge of the composition of the hydrocarbons. If the hydrocarbons contained on the average 12 atoms of carbon, the sensible heat of a gas containing M L.M. of carbon as hydrocarbon would be of the order of

$$M \times \frac{22}{12} \times t.$$

Where N is the weight of carbon as hydrocarbons in lbs., N = 12 M, and the sensible heat of the vapour is

N × 0·15 t C.H.U. per lb.,
or N × 0·27 t B.Th.U. per lb.

If the hydrocarbon material is condensed, adopting a low value for the latent heat, we have for the total heat 0° to t°:

N (0·15 t + 60) C.H.U. per lb.,
or N (0·27 t + 100) B.Th.U. per lb.

It appears to me that the value adopted by the Research Committee of the Institution of Gas Engineers—

N (0·8 t + 180)

is too high. I hope that I am correct in coming to this conclusion, for when one has to rely on data of doubtful value it is comforting to know that their numerical values are small.

It is obvious that there are many methods of constructing thermal balance-sheets; and though the method which I have outlined meets my own requirements, it may not be the best for general use. However, it is a matter of some importance that agreement should be arrived at as to some of the conventions to be adopted, as, for instance, the datum temperature; and the subject is worthy of consideration by a committee representing those interested.

PULVERIZED FUEL.

An Interesting Address in London by Mr. John Anderson.

On Thursday evening, the 17th ult., the Underfeed Stoker Company, Ltd., gave a private dinner at the Connaught Rooms, London, to about 150 prominent engineers; the chief guests being the Rt. Hon. Frank Hodges, M.P. (Civil Lord of the Admiralty), and Mr. John Anderson (the Chief Engineer of the Milwaukee Electric Railway and Light Company).

Mr. Anderson is, of course, known throughout the world as the pioneer of pulverized fuel firing for water-tube boilers, and in December, 1920, he started up 40,000 KW. of the famous Lakeside Station on Lake Michigan at Milwaukee, working entirely with "Lopulco" pulverized fuel—being the first power station in the world to be so operated. This plant was an immediate success, and to-day it remains the most efficient boiler plant in the world, running at 85 to 86 p.ct. efficiency all the year round. Mr. Anderson has probably had more practical experience of pulverized fuel than any man living, having already burnt over 1,250,000 tons of coal at Lakeside, and tried all kinds of pulverized fuel appliances —especially on the older Oneida Street Power Station, Milwaukee (which was one of the first fitted with "Lopulco" pulverized fuel), on which also the most elaborate tests were carried out by the United States Bureau of Mines. As a result of Mr. Anderson's pioneer work, an entirely new standard has been set for power station boiler plant efficiency, and many of the largest and most efficient power stations in the world have adopted pulverized fuel; the total amount of coal now being burnt for steam boilers exceeding 3,000,000 tons per annum.

Mr. Anderson, with the aid of numerous slides, gave a detailed description of the Lakeside Station, especially the new extensions, of which the second 40,000 KW. is now in operation and the third 40,000 KW. under construction. He described his earlier experiences in a fascinating manner, and furnished a mass of data with regard to performance figures. It is understood that these will be printed in the immediate future, and will form a document of the greatest interest and value to all power station engineers. Mr. Anderson stated that the water screen had never given the slightest trouble, and was no more likely to break down than the tubes of the boilers themselves, and that the capital cost of pulverized coal equipment did not exceed that of mechanical stoking based on the same steam output. He also pointed out that the wear and tear on the brickwork, because of the hollow air-cooled walls and the water screen, was less than with mechanical stoking —especially since combustion was completed in the extensive chamber space, and the flames did not impinge on the walls.

In the new extensions at Lakeside the "Wood" gravity dryer, using the exit flue gases only for drying, is being employed, instead of the long separately fired horizontal revolving dryer; while steel tube economizers are used, built into the setting under the boilers. Mr. Anderson still believes in a comparatively low-roofed boiler house occupying much more floor space and having the drying and pulverizing house as a separate, though adjoining, building, but with waste heat gravity dryers, as already stated. Most of the other latest designs, however—such as Cabokia, Cleveland, Trenton Channel, Colfax, Vitry, together with Willesden and St. Pancras in London—are on what may be termed the high-roof principle, each boiler having its own complete and independent auxiliaries. At Birmingham, of course, a separate pulverizer house is being adopted, because the plant was originally intended for mechanical stoking; and this installation will be rather an interesting illustration of the flexibility of pulverized fuel as regards design.

TREATMENT OF EFFLUENT SPENT LIQUORS FROM THE DISTILLATION OF AMMONIACAL LIQUOR.—II.

(*Concluded from p.* 452.)

LABORATORY EXPERIMENTS.

Two filters were tested side by side. They were worked at room temperature and fed with effluent liquid "B" (Table 4) diluted to the desired strength with tap water. Two types of filter were used:

(*a*) A cylindrical form, 2 ft. high by 9-in. diameter, packed with pieces of clean hard coke, 1-in. to 2-in. diameter, with 3 in. of fine coke above.

Approximate volume of packing . . . . . 0·9 c.ft
100 c.c. of liquor fed on by pipette half-hourly (= 1600 c.c. per day of 8 hours) on such a filter would correspond to $\frac{1600}{0{\cdot}9} \times \frac{27}{4536} = 10{\cdot}6$ gallons per cubic yard per day.

(*b*) A cylindrical form, 12·5 in. deep by 13·5 in. diameter packed with graded coke; 2 in. of $\frac{3}{4}$-in. to 1-in. below; 9 in. of $\frac{5}{16}$-in. to $\frac{1}{2}$-in. above; 1½ in. of $\frac{1}{10}$-in. to $\frac{1}{8}$-in. diameter above.

Approximate volume of packing . . . . . 1 c.ft.
100 c.c. of liquor fed on by pipette half-hourly (= 1600 c.c. per day of 8 hours) would correspond to $\frac{1600}{1} \times \frac{27}{4536} =$ 9·5 gallons per cubic yard per day.

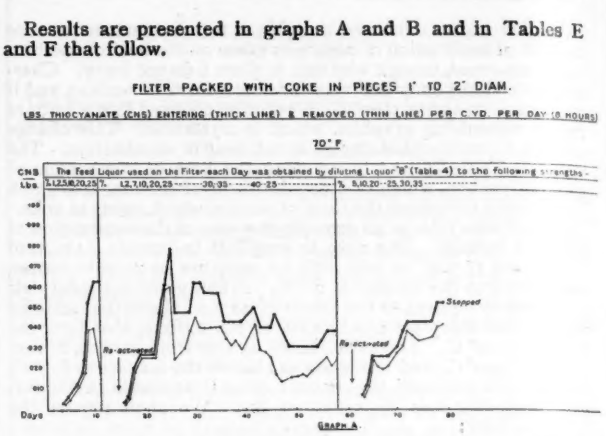
TABLE D.—*Effect of Boiling Effluent Spent Liquor in Open Pan.*

	Effluent from Settling Pits (including devil liquor).				
		Boiled in open pan with closed steam coil. Volume reduced from 40 to 26 gallons.		Four litres of "B" boiled in flask 2 hours in current of steam. Residue re-diluted to 4 litres.	
	Before Boiling.	Liquor as concentrated.	P.Ct. removed of total taken.	Liquor as re-diluted.	P.Ct. removed of total taken.
Liquor	"A"	"B"		"C"	
Composition of liquor— Parts per 100,000—					
Phenol as C_6H_5OH .	135	172	17	103	40
Thiocyanate as CNS	152	240	*Nil*	241	*Nil*
Thiosulphate as S .	75	40	..	51	..
Oxygen absorbed—					
(4 hours, 27° C.) .	400	580	6	..	..
(3 minutes, 27° C.)	..	528	..	..	..
After Exposure to Air:					
Oxygen absorbed (3 mins., 27° C.)-					
After 16 days.		509	..	395	22
,, 28 days.		484	..	..	..
,, 49 days.		457	..	..	..

The feed liquor "B" was obtained at a sulphate of ammonia works by boiling down 40 gallons of crude effluent liquor "A" to a volume of 26 gallons in an open pan and diluting the product as required for the experiments. Correction was made in the analyses for decrease in the figure for oxygen absorbed due to slow oxidation of the liquor on exposure to air in the cask in which it was stored.

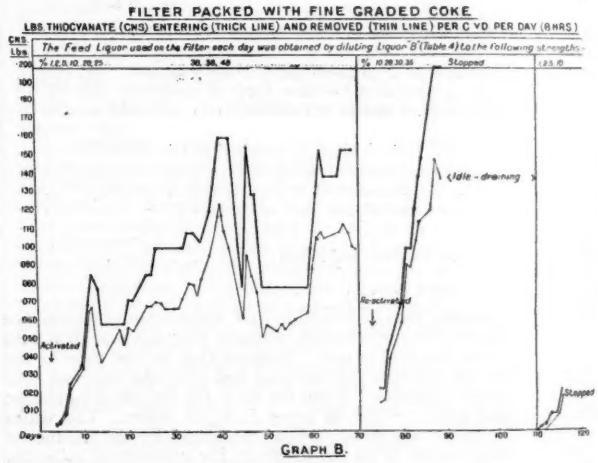
It is of interest to note the very partial volatilization of phenol that takes place on boiling the liquor (see Table D.) A much higher volatilization figure is obtained for the dephenolating tower at Hornsey, where a large moving body of hot gases and steam is in contact with the liquor on the packing.

Results are presented in graphs A and B and in Tables E and F that follow.


FILTER PACKED WITH COKE IN PIECES 1" TO 2" DIAM.
LBS. THIOCYANATE (CNS) ENTERING (THICK LINE) & REMOVED (THIN LINE) PER C.YD. PER DAY (8 HOURS)
70° F
CNS Lbs.
Days
Re-activated
Re-activated
Stopped

GRAPH A.

Graph A relates to the filter packed with large-sized coke. Abscissæ denote daily periods, ordinates the amount of thiocyanate entering and removed for the system corresponding thereto, calculated as lbs. of CNS per cub. yard of packing per day of 8 hours. The filter material was activated with a diluted extract of cow dung, well circulated to distribute the organisms, and this was subsequently displaced by a 1 p.ct. solution of the diluted extract followed by successive doses of diluted feed liquor "B" of gradually increasing strength. Results indicate that a filter of the character described is somewhat sensitive to changes in the composition and rate of flow of the feed liquor and has a relatively low efficiency—not exceeding the equivalent of 0·04 to 0·06 lb. CNS per cub. yard per day. Re-activation of the filter is readily effected, however, by treatment with diluted extract of cow dung in the manner described above.


FILTER PACKED WITH FINE GRADED COKE
LBS THIOCYANATE (CNS) ENTERING (THICK LINE) AND REMOVED (THIN LINE) PER C YD PER DAY (8 HRS.)
CNS Lbs
Days
Activated
Idle - draining
Re-activated
Stopped

GRAPH B.

Graph B shows the corresponding results obtained with the filter packed with graded coke of small size. The efficiency is here much higher than with the coarser packing. Liquor of 45 p.ct. strength "B" [and so containing 77 pts. phenol, 108 pts. thiocyanate (CNS), and 260 pts. oxygen absorbed per 100,000 pts. (4 hours' test)] can be successfully dealt with up to a maximum of 0·15 lb. per cub. yard per day.

In Table E comparison is made between the efficiency of the two forms of packing.

TABLE F.—*Work Done in Various Sections of Filter. Fine Graded Coke. 70° F.*

	Entering Filter. Total Weight. Lbs. per Day.				Removed. P.Ct. of Total Entering.		
	Phenol as C_6H_5OH.	Thiocyanate as CNS.	Thiosulphate as S.	Oxygen Absorbed. 3 Mins. 27° C.	Thiocyan te.	Thiosulphate.	Oxygen Absorbed.
Period, 5 days. Prior to re-activation of filter.							
Feed Liquor.—Average strength 45½ p.ct. "B." per day.	·1055	·1480	·0245	·2980	13·7 gals. per c.yd.		
Liquor as fed .	·1055	·1480	·0245	·2980	..	..	..
Effluent—							
4 in. down .	..	·1090	·0090	·1555	26	63	48*
8 ,, ,, .	..	·0425	*Nil*	·0510	45	37	35†
12 ,, ,, .	..	·0415	*Nil*	·0545	1	*Nil*	*Nil*
			Total		72	100	83

Period, 15 days. After re activation of filter.

Feed Liquor.—Average strength 28·5 p.c. "B." 14·0 gals. per c.yd. per day.

Liquor as fed .	·075	·1050	·017	·190	..	..	..
Effluent—							
4 in. down .	..	·0755	..	·0930	28	..	51*
8 ,, ,, .	..	·0365	..	·0255	37	..	35†
12 ,, ,, .	..	·0208	..	·0130	15	..	7
Total					80	..	93

* Effluent pale st aw. † Effluent colourless.

After 63 days' working, two collecting troughs were inserted in the coke packing of the second filter, in order to determine the work done in the different sections of the column. Analysis showed that the bottom section of the filter was inactive. The filter was laid off on the 70th day and re-activated, with the result that the bottom section was brought into action, and the total efficiency of the filter as a whole was raised from 83 to 93 p.c.

On the 89th day the filter was laid off and allowed to drain for three weeks. It was then fed successively with liquor of increasing strength (1 to 10 p.ct.). Results indicate that the material was still active (Graph B).

I desire to accord my sincere thanks to Dr. H. T. Calvert and Dr. H. G. Colman for valued information on various points connected with the inquiry, and to Mr. H. C. Smith and his Chemist, Mr. P. C. Gardiner, for their co-operation in the carrying-out of works-scale experiments. Mr. Linder must be given special thanks for the untiring energy he has displayed throughout the whole of the investigations.

TABLE E.—*Efficiency of Coarse and Fine Graded Packings Compared. 70° Fahr.*

Filter.	Total Period of Test—Days.	Feed Liquor ("B" Diluted). Average Strength Used, P.Ct.	Rate of Flow, Gallons, per C.Yd. per Day (8 Hrs.)	Weight in Liquor Fed. Lbs. per C.Yd. per Day (8 Hrs.). Phenol—as C_6H_5OH.	Thiocyanate—as CNS.	Oxygen Absorbed—(3 Mins. 27° C.)	Exit Liquor Weight in Effluent. Lbs. per C Yd. per Day. Thiocyanate—as CNS.	Oxygen Absorbed—(3 Mins. 27° C)	Removed P.Ct. of Total Entering. Thiocyanate.	Oxygen Absorbed.
Coarse packing—										
1	47	25·5	7·0	·0295	·0408	·0865	·0121	·0201*	70	80*
2	21	25·5	5·5	·0245	·0340	·0660	·0054	..	84	..
Fine graded—										
1	70	32·0	12·5	·0646	·0950	·1930	·0250	·0510†	74	80†
2	19	28·5	14·5	·0750	·1050	·2000	·0208	..	80	..
Maximum . . .	2	35·0	24·0	·1430	·2000	·3800	·058	..	70	..

* Calculated on 9 sets of inlet and outlet tests.
† ,, 15 ,, ,, ,,

CARBON MONOXIDE IN PUBLIC GAS SUPPLIES.

Mr. W. J. A. Butterfield's Report.

We were able to give in the last issue of the "JOURNAL" (pp. 510-13), in connection with the report to the Board of Trade by Mr. W. J. A. Butterfield, M.A., F.I.C. (one of the Gas Referees), on "Accidental Deaths by Poisoning from Public Gas Supplies" the conclusions and recommendations, together with correspondence thereon between the National Gas Council and the Board of Trade. This is now followed by an indication of the lines taken by Mr. Butterfield in the body of the report—which is published by H.M. Stationery Office, Imperial House, Kingsway, London, W.C., and Branches, at the price of 2s. 6d. net.

Mr. Butterfield opens by remarking:

The question whether the risk of death from accidental poisoning by gas from public supplies has become greater in recent years than formerly, is one which has been inquired into from a particular standpoint by two Departmental Committees—namely, that appointed by the Home Secretary in 1898, under the Chairmanship of Lord Belper, and that appointed by the President of the Board of Trade in 1921, of which Sir William Pearce, M.P., was Chairman.

The standpoint of investigation was substantially the same in both inquiries—whether limitation of the proportion of carbon monoxide in gas supplied for domestic use was necessary or desirable with a view to preventing increase in the risks of poisoning by escapes of gas. Wider issues—such as the general question of means of reducing the risks of poisoning from public gas supplies—were omitted from the terms of reference to these Committees, and were almost entirely disregarded by both of them. It appears to have been accepted almost without question that any observed increase in the number of fatalities arising from poisoning by gas derived from public supplies was due to an increase in the proportion of carbon monoxide in the gas supplied. Concurrent increase in the number of persons exposed to the risk was almost wholly overlooked, and concurrent changes in other conditions which might be the determining or chief factors in the risks experienced were but little investigated. It will appear from this report that the limitation of terms of reference to the two Committees, and the limitation of outlook on the part of almost all others who have inquired into or reported on this question in the past, have led to false conclusions and wrong inferences being drawn, and to failure to recommend more obvious means for reducing the risks to which the public is exposed.

CARBON MONOXIDE.

Dealing with carbon monoxide, Mr. Butterfield states that nearly 30 p.ct. of the gas sold in England and Wales is coal gas, without admixture or modification. It contains over 90 p.ct. of inodorous constituents, one of which is carbon monoxide, which is highly poisonous, and occurs to the extent of 7 or 8 p.ct.

The toxicity of coal gas and other gases which are available for supply to the public rests almost solely on their content of carbon monoxide. It is generally accepted that a person in good health will die if exposed during sleep for a period of about four hours to air which contains about 0·25 p.ct. of carbon monoxide. More or less than this proportion will bring death after shorter or longer exposure. Even as little as 0·10 p.ct. may occasionally kill after very prolonged exposure, though there is comparatively little risk of fatal results from an all-night exposure to air containing less than 0·15 p.ct. of carbon monoxide.

If air contains about 3·1 to 3·3 p.ct. of ordinary coal gas, a sleeping person breathing it will expire after about four hours. If the air contains, instead of ordinary coal gas, the same proportion of a gas containing about 6 p.ct. more carbon monoxide—such as is supplied by several large gas undertakings—the person breathing it would expire in less than four hours; or he would expire in about four hours if the proportion of gas in the air were only 1·7 to 1·8 p.ct. By reason of a Special Order issued by the Board of Trade in February, 1922, no gas undertaking may supply gas for domestic purposes containing carbon monoxide "unless such gas possesses the distinctive pungent smell of coal gas." It is conceivable that gas complying with this Order might be supplied containing so much carbon monoxide that if the proportion of gas in the air breathed were as low as 0·65 p.ct., death would ensue in four hours; but, as a fact, such gas has never been supplied in this country, except perhaps under war-time emergency conditions or on a negligible scale. In almost all cases in which the gas supplied contains more carbon monoxide than the 7 or 8 p.ct. which is present in ordinary coal gas, the increase arises from the use of steam in the gas-making processes, whereby more or less water gas is produced.

The manufacture of water-gas and its bearing on the coke disposal problem are discussed, and then the dangers of gas escapes are referred to. Mr. Butterfield says it cannot be too strongly emphasized that coal gas or any gas which can, as a practical proposition, be supplied for domestic use in this country, renders the air of rooms poisonous when it escapes unburnt into them. It is only a question of degree between coal gas and other gases, such as water gas (and water-gas mixtures), which contain more carbon monoxide. In practice, under the conditions of gas consumption in this country, the other gases which have been supplied in increasing proportions for thirty years past in many areas cannot be proved to have affected materially the number of fatalities from accidental gas poisoning. The variations in number of such fatalities depend at the present time primarily on other factors than a difference in the proportion of carbon monoxide in the gas supplied.

As there are reasons, quite apart from its relatively lower toxicity, why coal gas (if it can be supplied at the same price on the thermal basis) would be preferable to mixed gas in many areas, Mr. Butterfield thinks that efforts to improve the demand for gas coke by the public should be encouraged; and in this connection he points to the article by Prof. C. V. Boys, F.R.S., on p. 81 of the "JOURNAL" for Jan. 11, 1922, on "The Domestic Coke Fire," as showing that unbroken gas coke will burn to perfection, even as a small fire, if used on a firebrick hearth, without under draught, and without contact with metal conducting surfaces. Unless the price of gas is to be increased, no other steps can effect any considerable reversion to ordinary coal gas on the part of the undertakings which are now supplying gas containing more carbon monoxide than does coal gas.

FORMULA FOR CARBON MONOXIDE IN GAS.

After quoting facts and figures bearing out the view just set forth, Mr. Butterfield proceeds:

It is possible to ascertain readily, without resort to frequent analysis of the gas, what is approximately the average proportion of carbon monoxide in it over a certain period. It has already been stated that ordinary coal gas contains on the average nearly 8 p.ct. of carbon monoxide. Uncarburetted or blue water gas similarly contains about 42 p.ct., which percentage is diminished, when the water gas is carburetted, by about 4 for every gallon of oil used per 1000 c.ft. of the carburetted gas. Adopting these figures, which will not lead to underestimation of the proportion of carbon monoxide, it is possible to use a simple formula for calculating the average proportion of that constituent in the gas made by any undertaking over any period for which the quantities of coal gas and water gas made and of oil used in that period are known. The formula is:

$$\frac{8\,C + (42 - 4\,X)\,W}{100}$$

in which C is the percentage of coal gas, W the percentage of water gas (blue or carburetted), and X the number of gallons of oil used per 1000 c.ft. of carburetted water gas. Since the mixed gas consists only of coal gas and water gas (blue or carburetted) W = 100 − C.

For comparative purposes as between the same gas undertaking's supply at different periods, and as between the supplies of different gas undertakings in England and Wales, this formula gives results sufficiently accurate for all necessary deductions as to the relative toxicity of public gas supplies at different times and places. It is not, without modification, applicable to Scotch supplies, because the coal gas, as produced from most Scotch coals, contains appreciably more than 8 p.ct. of carbon monoxide. It is fairly obvious that, in the long run, such influence as more or less carbon monoxide in the gas supply of a district may have on the risks of accidental poisoning from gas escapes will depend on the average proportion of that constituent rather than on its maximum during the period under consideration.

Spasmodic analyses of the gas supplied in any area, he adds, give little information on the significant factor of the average proportion of carbon monoxide in the gas supply over a period of (say) twelve months; and it would be a matter of considerable difficulty to secure a continuous record of the content of carbon monoxide which would be as trustworthy as the information given by the foregoing formula.

All that is needed for the application of the formula is that the gas undertakings should be under obligation, when called upon, to furnish the Board of Trade with certified statements of the quantities of coal gas and water gas made, and of coal and oil used in gas manufacture, during whatever period may be the subject of inquiry. The gas produced in vertical retorts to which steam is admitted should be regarded as ordinary coal gas only up to a yield of 12,700 c.ft. per ton of coal, which, according to the best carbonizing results (*e.g.*, those of the South Metropolitan Gas Company), is the maximum yield of true coal gas obtainable from good gas coals. Any gas obtained per ton of coal in excess of 12,700 c.ft. may be regarded as water gas, in so far as its content of carbon monoxide is concerned, without risk of any serious error being incurred.

The formula quoted has been utilized for an exhaustive investigation of the proportions of carbon monoxide in the gas supplied by practically every undertaking in England and Wales during the past ten years, and in some cases for a longer period. Definite information has thus been obtained by which to test the truth of the statements that have been freely promulgated to the effect that large increases have taken place in recent years in the proportion of carbon monoxide in the gas supplied by gas undertakings, and in particular by certain gas undertakings in whose districts there happens to have been an increase in fatalities by poisoning from accidental escapes of gas.

DEATHS BY GAS POISONING.

Alluding to accidental death by gas poisoning, Mr. Butterfield remarks that, while the total number of accidental deaths from gas poisoning has increased since the introduction of water gas, the increase for the greater part of that time has followed *pari passu* the increase in the use of gas.

It is curious, he says, that the enormous growth in gas supply in the last thirty years has been generally overlooked when the fatal accidents due to gas poisoning have been discussed. In 1891 (the last year in which all the gas supplied in England and Wales was coal gas) 1,959,393 premises were supplied; but by the close of 1922 this number had grown to 6,902,465. There were fifteen deaths registered in 1891 as being due to accidental coal gas poisoning; but since then various circumstances have arisen which make the chances of accidental poisoning from ordinary coal gas greater now than was the case in 1891. The number of fatal accidents fluctuates from year to year; but it would be rash to ascribe these fluctuations to any particular cause—the truth being that the number in any year is so small in relation to the widespread employment of gas that comparatively few purely fortuitous happenings in one period are apt to be given a significance which is unreal.

In his view, the following table shows that the course of events up to about 1914 fully justified the Legislature in refraining from acting upon the recommendation of the 1899 Committee presided over by Lord Belper that a limit should be placed upon the percentage of carbon monoxide permissible in gas. Up to 1914, increasing proportions of carbon monoxide had not affected the death rate, and the excess of deaths over expectation in 1921 and 1922 in particular was almost certainly due mainly to other causes than the slight further increase in the average carbon monoxide content of the gas supplied.

Accidental Deaths Attributed to Gas Poisoning from Public Gas Supplies in England and Wales.

Year.	Number of Premises Supplied with Gas.	Number of Deaths Registered.	Expectation of Deaths on 1899 Basis.	Death Rate, Number of Premises Supplied per Death per Annum.
1899	2,945,793	25	—	117,832
1900	3,142,701	21	27	149,652
1901	3,332,330	24	28	138,847
1902	3,558,793	29	30	122,717
1903	3,798,169	16	32	237,386
1904	4,072,815	25	35	162,913
1905	4,370,338	35	37	124,867
1906	4,603,220	49	39	93,943
1907	4,904,524	51	42	96,173
1908	5,126,746	39	44	131,455
1909	5,352,743	65	45	82,350
1910	5,584,086	27	47	206,818
1911	5,787,185	34	49	170,211
1912	5,993,141	58	51	103,330
1913	6,204,614	40	53	155,115
1914	No Returns	53	—	118,345†
1915	,,	69	—	91,884†
1916	,,	69*	—	92,865†
1917	,,	86	—	75,295†
1918	,,	81	—	80,778†
1919	6,610,723	83	56	79,647
1920	6,700,699	82	57	81,716
1921	6,789,863	90	58	75,443
1922	6,902,465	112§	59	61,629
1923	Not yet known	56‡§	—	92,440†

* Possibly the number of deaths in 1916 was 71 instead of 69.
† Death rate estimated from *approximate* number of premises supplied.
‡ First nine months only of 1923.
§ These figures are the total number of reports received by the Board of Trade, and do not necessarily agree with the Registrar-General's Returns, which are not available at the time of writing this Report.

Some of the more significant changes which have taken place since 1891 in the ways in which gas is used are noted by Mr. Butterfield—*i.e.*, the great increase in the number of consumers among the poorer classes, owing chiefly to the prepayment meter, which generally serves smaller rooms than the ordinary meter, so that a given escape would be more serious in results; the growth of the use of gas in bedrooms and nurseries, where an escape of gas, unobserved by people asleep or by small children, has a greater opportunity of causing fatal results; and the great increase in the use of gas for heating purposes through appliances which allow larger quantities of gas to escape if accidentally turned on and left unlighted.

CLASSIFICATION OF CASES OF ACCIDENTAL GAS POISONING.

Out of 818 accidental deaths in England and Wales in 10¾ years to Sept. 30 last, fairly full information is available for classification in regard to 337 deaths; and it is possible to draw a fairly trustworthy inference from the circumstances as to what proportion of these cases would not have been fatalities had the gas supplied in all of them contained no more carbon monoxide than ordinary coal gas (which was, in fact, the gas supplied in a considerable number of the cases).

The gas undertakings in a large number of small towns and rural districts continue to supply ordinary coal gas. At the end of 1921 there were 613 small undertakings supplying 1,607,647 premises, of which rather less than one-half were supplied with ordinary coal gas throughout the ten years 1913-22. In this period of ten years, in the areas of these 613 undertakings 91 deaths were registered as due to accidental poisoning; and of these, 49 cases occurred in areas supplied throughout solely with ordinary coal gas, though the premises so supplied were fewer. The risk of accidental death from gas poisoning—averaging one per annum per 176,664 premises supplied with gas, or (say) per 700,000 persons who make use of gas—in the small towns and rural districts is so small that it would not be unreasonably described as negligible. There is no evidence of the risk having increased in the last five years; and no connection at all can be established between the incidence of accidental deaths and the carbon monoxide content of the gas.

It is a striking fact that in the districts of supply of no fewer than 538 of the small authorized gas undertakings in England and Wales there were no accidental deaths attributed to gas poisoning throughout the ten years 1913-22, though 1,229,952 premises took supplies of gas from these 538 undertakings, and to 48 p.ct. of such premises the supply throughout or at times contained more carbon monoxide than ordinary coal gas. It should, however, be mentioned in connection with these rather sweeping conclusions that the average proportion of carbon monoxide in the gas supplied in any small town or rural district in the ten years will not have been more than 25 p.ct. Statistics are not available for such areas in this country in regard to the supply of gas with higher proportions of carbon monoxide, and it ought not to be assumed that the risk of accidents from poisoning with such gas is no greater than with ordinary coal gas. In the absence of direct evidence to the contrary, somewhat greater risk may reasonably be presumed to ensue when the carbon monoxide exceeds the maximum proportion which practical experience in this country has already proved not to involve greater risk than attends a supply of ordinary coal gas. An

average of about 25 p.ct. of carbon monoxide represents the upper limit of past experience here.

As to medium-sized towns, there are in England and Wales 62 authorized gas undertakings each supplying between 10,000 and 20,000 premises. Four supply near suburbs of London, and the remainder independent towns. The view that a fair comparison of the bearing of the carbon monoxide content on the risks of accidental gas poisoning cannot be obtained unless the housing and living conditions of the districts under comparison are substantially the same, receives striking support from the difference in the incidence of accidental gas fatalities from gas poisoning as between the four suburban districts and the 58 independent towns. Of the 85 accidental deaths in ten years in the 904,332 premises supplied by the 62 medium-sized gas undertakings, no fewer than 19 occurred in the districts of the four suburban undertakings. If the conditions in these districts had been the same as in the 58 independent towns, the expectation of accidental deaths in the ten years would have been only five instead of 19. Eliminating the four suburban undertakings, the death rate from accidental gas poisoning during the past ten years in the medium-sized towns of England and Wales is one death per annum per 127,200 premises supplied with gas, or (say) per 500,000 persons who make use of gas in those towns. As with the rural districts, the facts relating to gas supply and fatalities in these towns do not furnish evidence in support of any measures for the imposition of a limitation in the proportion of carbon monoxide in the gas supplied. Investigation of the circumstances of many of the fatalities, however, indicates that the adoption of other measures would have reduced materially the number of the accidents which had fatal results.

Coming to the large towns, the report states:

There are in England and Wales 54 gas undertakings which each supply more than 20,000 premises, and together supplied at the end of 1922 a total of 4,401,141 premises. All these undertakings, as well as a few smaller ones, may be regarded as serving, in the main, congested urban districts, though in several instances the distributing systems extend into comparatively thinly populated outskirts of the big towns. The greater part of the premises supplied are, however, in densely populated neighbourhoods, and in this respect these large gas undertakings stand by themselves in a class which is not comparable as regards housing and living conditions with the classes of small and medium-sized gas undertakings which have been dealt with in the preceding sections of this Report. The risks are greater not merely on account of the smaller cubic air space generally available per head in living and sleeping quarters, but on account of the more general use of gas for cooking, water-heating, and room-heating in both dwelling and business premises, and the greater deterioration through age and wear-and-tear of a large proportion of the internal gas piping and fittings. Gas supply was common in London and most of the large towns long before it reached the smaller provincial towns and rural areas, and in many old houses there are piping and fittings which have been in use for over half-a-century, and need systematic overhaul or renewal in order to make them reasonably safe for use at the present time. Such fittings, &c., however, are all too frequently retained in use until a serious leak develops, by which someone is exposed to grave risk of poisoning. In the smaller towns and rural districts a larger proportion of the piping and fittings is of relatively recent date, and less likely to have deteriorated through age and wear into an unsafe condition.

In view of these facts, it is not surprising that the death-rate from accidental gas poisoning is higher in the districts supplied by the 54 large gas undertakings than in the less thickly populated districts. For the last 10¾ years it is as nearly as possible one death per annum per 75,000 premises supplied with gas, or (say) one death per annum per 300,000 persons who make use of gas in our large towns.

While the large towns supplied with ordinary coal gas are comparatively few in number, there is nevertheless very great diversity in the death rate from accidental gas poisoning among them. Thus, taking two large industrial towns, in both of which the Corporations supply ordinary coal gas to about 80,000 premises, the death rate from accidental gas poisoning in the last 10¾ years is very nearly 13 times as high in one town as in the other. It is evident, therefore, that the death rate varies enormously in different districts, notwithstanding a uniformly low percentage of carbon monoxide in the gas supplied to them.

Reasons for the variation, in so far as it is not purely fortuitous, and dependent on the aggregate numbers in the 10¾ years being too few to afford a fair average, may be suggested; and some light has been thrown on the matter by information given by the two largest gas undertakings which supply ordinary coal gas (or gas which differs from it very little in respect of carbon monoxide content). This information was given by the undertakings in question at the request of the Board of Trade.

Precautions by two Large Undertakings for Reducing Risks of Accidents from Coal Gas.

The larger of the two undertakings has eliminated from its district the dangerous water-slide pendants, by conversion, in many cases free of cost to the consumer, to fixed pendants. The quality of all classes of fittings supplied by the undertaking to consumers receives special attention. *Seamless* brass tubing; taps of a type specially designed to avoid parts becoming loose, and fixed horizontally wherever possible; best-quality iron barrel for service pipes, whether indoor or outdoor; and a carefully trained staff of fitters to undertake practically all the fitting work in the district, with selected material and fittings, are other means adopted by this undertaking which are believed by its management to have been instrumental in reducing the number of deaths from accidental gas poisoning in its district.

The smaller of the two undertakings has also undertaken the conversion, free of charge, of water-slide to fixed pendants, and has thus converted a great many, but reports that a considerable number of consumers refuse to allow the conversion. This undertaking attaches the greatest importance to escapes of gas being promptly reported to it, and issues special notices on the gas accounts, and special instructions to its staff and workmen in regard to all escapes, as well as having arrangements with the police and others for the prompt notification of outdoor escapes. Leakages, &c., on prepayment meter supplies are attended to free of charge, as also are those on other supplies, if the repair will not take the fitter more than one hour; but if it is more serious, temporary measures only are taken by the undertaking's staff, and the consumer is notified both verbally and by letter that it should be attended to forthwith at his expense. Escape work is given precedence over all other work, and the houses of a number of workmen who live near the undertaking's workshops are connected by telephone, in order that these men may deal with escapes reported after ordinary working hours; and motor vehicles are available to convey them in case of urgency to any part of the district.

The measures adopted by these two undertakings, which together supply with gas well over half-a-million premises, have clearly been instrumental in reducing the accidental death rate from gas poisoning in their districts very much below that of many undertakings which supply only coal gas, or gas containing substantially the same proportion of carbon monoxide as coal gas.

Effect of Neglect of Similar Precautions by some Other Undertakings.

It is known that some other gas undertakings have adopted somewhat similar measures to those of the two undertakings mentioned in the preceding section, but it must also be recognized that there are some districts where such precautions have hitherto been almost entirely neglected except on prepayment meter supplies. Generally speaking, the latter districts, whether supplied with coal gas or with gas containing a higher proportion of carbon monoxide, have a relatively high death rate from accidental gas poisoning, though certain other factors which are equally independent of the composition of the gas undoubtedly play a part in determining the death rate. The wide divergencies in the death rate from accidental gas poisoning in towns supplied with ordinary coal gas, and the comparatively high rate in certain of those towns, make it clear that, in modern conditions, very little greater security would be afforded to consumers of gas if all the gas undertakings reverted to the supply of ordinary coal gas, and in other directions took no further precautions than at present. On the other hand, it is equally clear that the general adoption of precautionary measures such as those practised by the two undertakings mentioned in the preceding paragraph, would greatly advance the security of consumers, whatever the character of the gas supplied.

(To be concluded.)

The New "Michael and Will."

We have received from Messrs. Butterworth & Co., Bell Yard, Temple Bar, London, E.C., a copy of the seventh edition of "Michael and Will on the Law Relating to Gas and Water." The volume to hand deals exclusively with gas, and has been edited by Mr. F. T. Villiers Bayly, of the Middle Temple. For this edition, it has been decided to have two volumes—separating the two subjects with which the work deals—and to make each volume complete in itself. Vol. 1 therefore deals with gas only; and this will be found of considerable advantage, in view of the changes that have been made in the law relating to gas undertakings by the passing of the Gas Regulation Act, 1920. We shall be giving a further notice of the volume in a subsequent issue of the "JOURNAL." Meantime, it may be mentioned that the price is 50s. net.

Pioneering as a Policy.

Writing under this heading in the American Gas Association Monthly, Mr. R. O. Jasperson says he knows of at least two gas and electric companies who have embarked upon the task of procuring industrial surveys for their respective territories. An industrial survey should seek to ascertain certain economic facts relating to population, manufacture, agriculture, transportation, financial resources, &c., to show the trend of each and the bearing of each upon the community. A survey may show the necessity for bringing in more people and more industries to support them, or it may indicate that there is a slackness in all the wealth-producing factors. The larger view of the survey is that it provides a chart for future programmes of expansion; it makes planning more intelligent; it should result in fewer mistakes; and it gives the utility a clearer conception of its true relationship to the community. An accurate economic survey equips a utility with information that gives it power to lead. Gas companies possess exceptional facilities for studying population characteristics, housing and industrial conditions, increasing or decreasing power and fuel demands, &c. Census figures, bank clearings, freight movements, and manufacturing outputs are easily available; and when assembled in the form of a survey with proper deductions made, one can construct curves that tell the story of the past, of the present, and to some extent of the future. A gas company should share this information with the community. Industrial surveys will be more common in the future, for gas companies feel the need for a more accurate knowledge of conditions.

Price of Gas Oil.—The "Petroleum Times" announces that the price of gas oil has been reduced by ¼d. per gallon as from the 2nd inst. The current quotation is therefore 5¼d. per gallon, net and naked, *ex* wharf.

CORRESPONDENCE.

[*We are not responsible for opinions expressed by Correspondents.*]

Becker Ovens—A Correction.

SIR,—With reference to the brochure which we recently sent you describing the Becker oven, we find that an error was made in the results of the working of a typical battery given therein. Owing to an obvious misprint, the sulphate of ammonia yield was given as 28·2 gallons, whereas it should have been 28·2 lbs.

For the Woodall-Duckham Vertical Retort and Oven Construction Company (1920) Limited.

D. RIDER, Director.

52, *Grosvenor Gardens, S.W., Aug.* 5, 1924.

[Owing to this error, the working results of the Becker oven were criticized by a correspondent in our issue for July 30, p. 463.—ED. "G.J."]

Fireclay Retorts at Keighley.

SIR,—In reply to Mr. G. M. Gill's letter in your issue for July 30, I beg to say that the analysis of the retorts supplied to Keighley was given in Mr. Emery's paper under heading B.4, and shows the silica content as 74·40 p.ct.; and in a letter received from Mr. Emery after the Institution meeting, he particularly requested that we should contradict Mr. Gill's statement that the retorts were "siliceous."

Neither Messrs. Drakes, Ltd., the designers and constructors of the installation, nor Mr. Bromley, the Engineer at Keighley, have any knowledge of these retorts being described to Mr. Gill as "siliceous"; and without entering upon any discussion with Mr. Gill as to the exact meaning of this word as applied to gas retorts, I state very definitely that the retorts which have given such excellent service at Keighley are *fireclay*, as reference to the analysis will plainly show.

H. J. C. JOHNSTON, Director.

The Leeds Fireclay Company, Wortley, Leeds, Aug. 8, 1924.

Fire at a Melbourne Gasholder Station.

SIR,—My attention has been drawn to a paragraph in your issue of May 21, which has just arrived in Melbourne, regarding the fire at this Company's North Melbourne gasholder station; and I regret that you have been misinformed generally as to the occurrence. The fire was due to the ignition of escaping gas from a hole which was being drilled in the side sheeting preparatory to fixing a patch. No electric welding was being employed at the time of the fire, and the ignition was apparently caused by the sparking of the commutator of the electric drill. Though the fire was alarming, the damage, apart from that caused to the holder, which was to be expected, was trivial. Perhaps it will interest your readers to know that the holder referred to was again in commission within 23 days.

J. N. REESON.

The Metropolitan Gas Company, 196, Flinders Street, Melbourne, July 7, 1924.

REGISTER OF PATENTS.

Gas Meters.—No. 218,769.

ALEXANDER, W. and PINCHBECK, LTD., both of Holloway, N.

No. 10,803; April 20, 1923.

In a gas meter constructed according to this invention two diaphragms are arranged back to back and located in a casing, but not separated by a partition; each diaphragm forming a compartment and the casing a third compartment—three separate compartments in all. The diaphragms actuate a pair of valves similar to those employed in a meter having four compartments, and special mechanism effects the correct timing of the inlet and exhaust ports, to ensure that when the port in one valve leading to the casing is opened to admit gas the port in the other valve is closed to exhaust.

In one form of construction the slide valves are linked to a rod pivoted at one end to the crank pin actuated by the diaphragms, while the other end is slidably mounted in a guide; the point at which the links are pivoted to the rod being located intermediate between the crank pin and the guide. By this means the point at which the links are pivoted to the rod is constrained to move in an oval instead of a circular path. In such an arrangement, when the casing is neither being filled nor emptied there is no pressure exerted by the gas in the casing tending to move the diaphragms, and consequently it is necessary so to connect the diaphragms together that movement of one shall compel the other diaphragm also to move. This is effected by connecting the motion rods of the two diaphragms by parallel motion links or in any other convenient manner.

The whole of the working mechanism and the diaphragms are mounted on the valve plate, which can then be secured to the top of the casing.

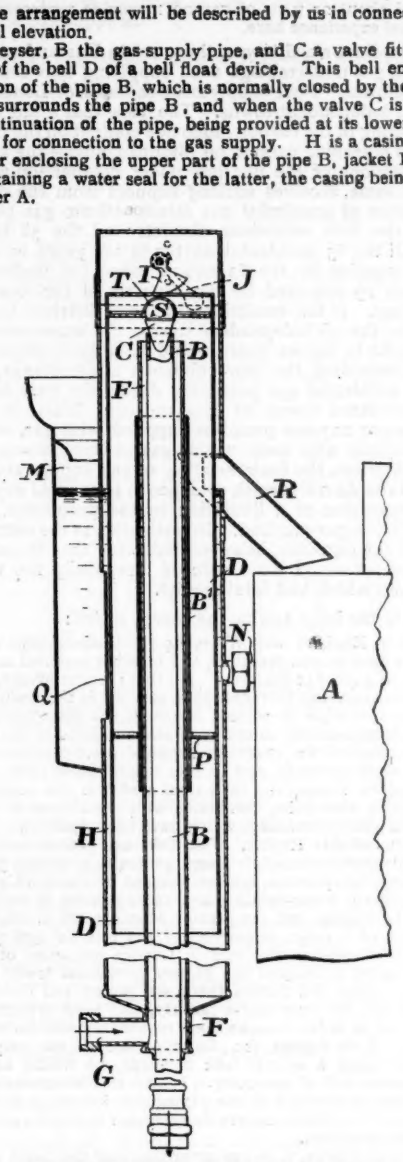
Water Heaters.—No. 218,572.

EWART, J. W. & J. H., both of Crouch End, N. 5.

No. 31,994; Dec. 20, 1923.

This invention relates to the automatic cutting-off of gas to a geyser in the event of gas or water failing. The feature of the invention is that a jacket is arranged round the gas-supply pipe for conveying the gas to the supply pipe and the "combined gasometer and float;" but the complete arrangement will be described by us in connection with the sectional elevation.

A is the geyser, B the gas-supply pipe, and C a valve fitted to the upper end of the bell D of a bell float device. This bell encloses the upper portion of the pipe B, which is normally closed by the valve C. A jacket F surrounds the pipe B, and when the valve C is opened it forms a continuation of the pipe, being provided at its lower end with a branch G for connection to the gas supply. H is a casing forming the chamber enclosing the upper part of the pipe B, jacket F, and bell D, and containing a water seal for the latter, the casing being attached to the heater A.



Automatic Gas and Water Cut-Off—Ewart.

M is a tank into which the water supply for the heater flows; N is a pipe by which M communicates with the chamber H and provides the water for sealing the bell D. B^1 is a guide tube connected to the bell D by the annular plate P and fitting loosely on the jacket F. The supply tank M is fitted to the casing H, with which it communicates by the opening Q; the bulk of the supply water passing from the casing H to the heater A by the spout R, which determines the level of water in the casing H. A small orifice is formed in the pipe connection N, so that, while not affecting the main supply through R, in the event of the supply of water to M failing, the water will gradually flow away into the heater and allow the combined bell and float D to fall and shut off the supply of gas.

The valve C fits loosely within a spherical socket T in the bell. I is a pivoted cam catch for retaining the bell in its lowered position with the valve closed, until released by the hand-lever J.

Heat Treatment by Molten Metal.—No. 218,807.

THERMAL, INDUSTRIAL, AND CHEMICAL (T.I.C.) RESEARCH COMPANY LTD., and RIDER, D., both of Grosvenor Gardens, S.W. 1.

No. 14,670; June 4, 1923.

(Patent of Addition to No. 174,974 of Sept. 7, 1920.)

This invention relates to a modification of that described in specification No. 174,974. The process of subjecting a material to heat treatment by bringing it into contact with molten metal described in that specification is one in which the effective heating or cooling is produced by causing the material to enter the re-entrant angle formed at the junction of a surface of the molten metal and a surface which is not wetted thereby and is travelling into the metal through its surface; the surface of a drum or disc revolving on an inclined or horizontal axis, while partly submerged in the molten metal, being cited in the specification as an example of a travelling surface.

In treating certain classes of materials in apparatus hitherto designed for this process, there has been difficulty in maintaining the contact between the molten metal and the material under treatment for a sufficient time to complete the destructive distillation or other heat

treatment—either the metal bath must be of unduly large dimensions, or the throughput of material must be very small.

By the present invention the time of contact of the material with the metal is increased, while retaining the bath of comparatively small dimensions. Relatively thin discs are used as the travelling surface, and a number of them is mounted on a shaft, there being two or more such shafts parallel to each other. The discs on one shaft are so placed relatively to those on the adjacent shafts, and the latter are at such a distance apart, that the discs overlap each other. The numerous discs afford a large surface for conveying the material in the form of thin films through the molten metal; and the fact that they extend between each other not only uses the space to the best advantage but prevents formation of agglomerations of the material.

To prevent the material from travelling over the surface of the metal without immersion, there may be transverse partitions between the discs extending into the surface of the metal. The discs as they emerge from the metal are continuously scraped beneath the surface —for instance, by scrapers arranged more or less radially against the surface of the discs.

Gas Taps.—No. 218,872.

MITCHELL, G. P., of Blackburn.

No. 20,898; Aug. 17, 1923.

This invention is for a tap, for gas and other supplies, which may be disengaged and rendered inoperative, thus preventing, for example, its accidental turning by children.

The patentee dispenses with the usual top portion of the tap so that merely a barrel part projects above the lower or body portion of the tap. A loosely fitting collar having an arm or lever pivoted thereon, which latter is capable of being brought into contact with the movable part of the tap, is provided. The collar with the lever may be turned about the tap without effect when disengaged.

The specification describes and illustrates these modifications of the idea.

Self-Locking Gas Floor Tap.—No. 218,920.

PERKS, C. J., of St. Leonards-on-Sea.

No. 30,935; Dec. 8, 1923.

This invention relates to a self-locking gas tap adapted to be fitted to a gas pipe at the floor surface, and has for its object to provide a simple and efficient means for preventing the tap from being turned on accidentally.

The fitting consists of a one-way gas tap of the plug type, having an elbow pipe integral with the casing, a floor plate, and outlet with nut; and on the periphery of the elbow pipe is a bracket for supporting a pivoted lever in a parallel position to the elbow pipe. The lever at the end remote to the gas tap is shaped to form a handle whereby it may be easily depressed against the action of a spring. The opposite end forms a key or locking means to engage with a disc immediately beneath the thumb piece of the gas tap and integral therewith. This has a small indent or slot cut in the periphery to receive the key portion of the lever when at the "off" position, and at the "on" position the key will rest on the periphery of the disc.

Carbonization.—No. 218,512.

HUMPHREYS AND GLASGOW, LTD., of Victoria Street, S.W. 1

(A communication from J. M. RUSBY, of Philadelphia.)

No. 19,824; Aug. 2, 1923.

The principal object of this invention is to provide for the carbonization of bituminous coal or other bituminous material and the production of mixed coal and water gas in cheap and compact apparatus, the operation of which demands little labour and from which the resulting coke is delivered at a low temperature approximating that of the atmosphere. The bituminous material is carbonized by the circulation therethrough, and in immediate contact with it, of the gas distilled from it and water gas produced by passing steam through the hot coke; these gases having been heated partly by passage through the hot coke, whereby the coke is cooled ready for discharge from the apparatus, and partly by further passage through a stove, or heater, or by the combustion of a portion of the circulated gases.

We reproduce an elevational view of apparatus described in the specification.

Fresh bituminous material is supplied to A, where it is kept permeable to the flow of gas by a stirrer. This permeability is of great importance, since it controls the rapidity and uniformity of carbonization. The gas contained, and evolved, in A is drawn by an impeller B, and forced upwards through the coke cooler C. The valve being closed, this partially heated gas is forced through connections to the top of one of a pair of stoves E (arranged in parallel), is heated, and is thence discharged through the valve F to the carbonizing vessel A. This heated gas rises through A, carbonizes the coal, and is discharged through the connection G. The portion of this gas required for re-circulation is withdrawn by the impeller B and is re-circulated; the surplus being discharged through plant H to the holder.

A portion of the heat of the coke in the vessel C is utilized for the production of blue water gas, which will then pass through the stove and the carbonizing vessel. This steam admission can be in conjunction with the re-circulation of gas as above described, or alternate with it.

Should it be desired to recover the ammonia and tar, then instead of the impeller drawing gas directly from G, the valve will be set to close the connection to the impeller, and the total gas from A and G will be passed through plant H, &c. The impeller will then draw the proportion of this gas (freed from its tar, ammonia, &c.) required for re-circulation through the connection K from these condensing vessels, and force it in succession, as above described, through the coke cooler, stove, and carbonizing vessel.

From this description it will be seen that the heat absorbed by the circulated gas in cooling the coke in C is all utilized in heating the gas for its succeeding use in carbonization. This makes the process highly efficient; the only heat required to be added to the gas by the stove being that needed to replace heat lost by radiation, or consumed or rendered latent in the drying and carbonization of the fresh coal supplied to A. As is apparent, it is the temperature of the stove E which fixes the maximum temperature of the carbonizing vessel A and all of its products. The control of temperature of this stove can be very accurate, and consequently the temperature of the carbonization of the coal can be made whatever is desired. By the proper choosing and control of this stove temperature, in conjunction with the choice and control of the quantity of gas re-circulated, serious injury to the re-circulated gas by the hot coke in either C or A, or by the stove, can be prevented. L is a producer.

This method of carbonization yields a substantially nitrogen-free coal gas, or mixed coal and blue water gas.

APPLICATIONS FOR PATENTS.

[Extracted from the "Official Journal" for Aug. 7.]

Nos. 17,924 to 18,533.

BREWSTER, A. W.—"Grease-guard for gas cooking-stoves." No. 18,523.

BREWSTER, M. M.—See Brewster, A. W. No. 18,523.

DUCKHAM, SIR A. M.—"Operating vertical retorts for carbonizing fuel." No. 18,478.

FINLAYSON, T. C.—See Duckham, Sir A. M. No. 18,478.

KOPPERS COMPANY.—"Coking coal." No. 18,242.

KOPPERS COMPANY.—"Coking-retort ovens." No. 18,248.

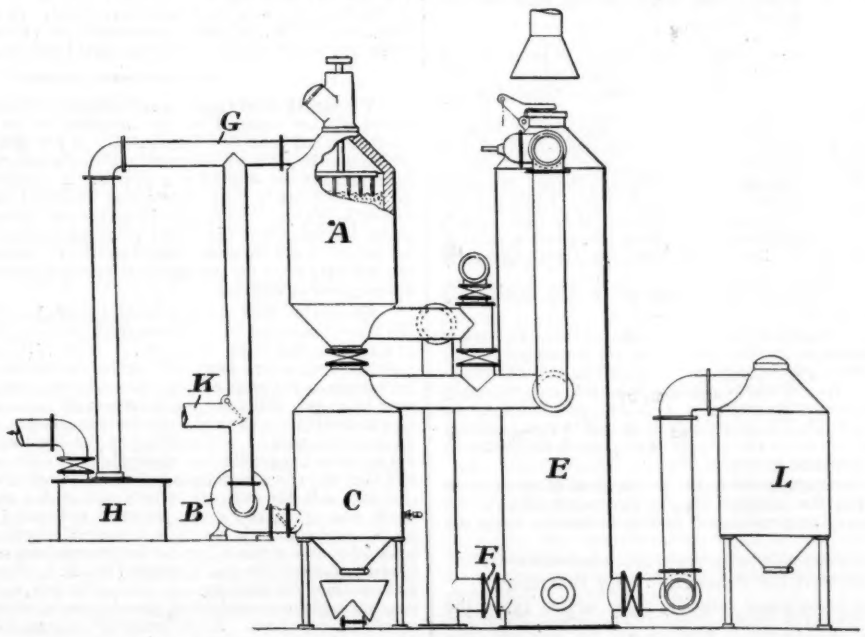
LILGE, F.—"Gas-burner for furnaces." No. 18,236.

RIGBY, A.—"Gas-heated wash-boilers." No. 18,159.

RUSHEN, P. C.—See Koppers Company. No. 18,242.

RUSHEN, P. C.—See Koppers Company. No. 18,248.

SMITH, E. W.—See Duckham, Sir A. M. No. 18,478.



Rusby's Carbonizing Plant.

PARLIAMENTARY INTELLIGENCE.

HOUSE OF LORDS.

Progress of Bills.

Rhymney and Aber Gas Bill: Returned from the Commons, agreed to, with amendments.

Manchester Corporation Bill: Returned from the Commons, agreed to, with amendments. These were considered, and agreed to.

Gas Regulation Act.

On the 4th inst,, the draft Special Orders relating to the gas undertakings mentioned in the last issue of the "JOURNAL" (p. 524) were approved on the motion of Lord Muir Mackenzie. The following Orders have also been approved: Settle Gas Company, Ltd., Sheffield Gas Company, Oxford Gaslight and Coke Company, Middlesbrough Corporation, Chertsey Gas Consumers' Company, Ltd., and the Wirksworth Gas Light and Coke Company, Ltd. The same Orders have been approved by the House of Commons.

The Oxford Gas Company's Order has the following modification: Clause 33, sub-clause (1), para. (*b*) omit "as provided by" and insert "the land described in the second schedule to this Order and to the extent provided in."

Royal Assented Bills.

The following Bills have received the Royal Assent: Manchester Corporation and the Rhymney and Aber Gas.

SMOKE ABATEMENT BILL.

On Friday, Aug. 1, the Public Health (Smoke Abatement) Bill was considered in committee by the House of Lords—the EARL OF DONOUGHMORE in the chair.

Earl DE LA WARR, in reply to a question, pointed out that the Bill was an addition to the Public Health Code. Scotland had a separate code from England, and therefore a separate Bill for Scotland would have to be introduced. He understood this would be done in the autumn.

Lord ASKWITH moved, and it was agreed, to insert the following new sub-section—

> (4) Within twenty-four hours after any alleged nuisance has occurred an intimation shall be given to the occupier of the premises in respect of which such nuisance is alleged.

He said that both the Federation of British Industries and the Smoke Abatement Society were anxious that this sub-section should be inserted. It had been tried in a voluntary manner in one or two towns. In Sheffield it was reported that the results of this action were good.

Consideration was then given to clause 2, sub-section 1 of which read as follows—

> (1) In any case in which by-laws for the purpose have been made by the local authority, the emission, during such periods as may be prescribed by the by-laws, of black smoke of such density and volume as may be so prescribed shall raise the presumption, until the contrary is proved, that the emission constitutes a nuisance.

Lord NEWTON moved that the word "black" be omitted. This, he urged, was a very important amendment. It was difficult to prosecute anybody under the existing law; and the difficulty had been enormously enhanced owing to the fact that it had to be shown that the smoke was "black." This, apparently was an extremely hard thing to do. It must be obvious to everybody that smoke could be equally objectionable even if it was not black. What was the sense, therefore, of leaving the word in? The result of including the word "black" was not only that prosecutions failed, but that local authorities were very reluctant to prosecute.

The amendment was agreed to.

Earl DE LA WARR then moved, and it was agreed, to leave out of the same sub-section the words "of such density and volume as may be so prescribed." It was, he said, not practicable to fix standards for density and volume.

Lord MARSHALL OF CHIPSTEAD proposed an amendment to sub-section 3, which was accepted, to leave out "administrative," and after "county" insert "of London and the Common Council within the City of London." He pointed out that the sub-section proposed that the London County Council should be the Local Authority for making by-laws within the Administrative County of London, which included the City. The amendment would have the effect of excluding the City, and making the Common Council the Local Authority for that area.

Earl DE LA WARR moved, and it was agreed, to add to clause 3 the following sub-section—

> (3) Where the Minister of Health is of opinion that any work is of such a character as is likely to cause the evolution of any noxious or offensive gas, he may, notwithstanding that the provisions of the Alkali, &c., Works Regulation Act, 1906, may not apply to that work, authorize an inspector appointed under that Act to enter and inspect such work; and the provisions of that Act relating to the powers of inspectors shall apply in respect of that work in the case of any inspector so authorized.

This, he said, gave the Minister the right, in the case of noxious or offensive gases, to enter the premises for the purpose of inquiry. It was obviously necessary that he should do this before he made the order.

Clause 4 was then taken; this being in the following terms—

POWER TO MAKE BY-LAWS RESPECTING NEW BUILDINGS.

> (4) The powers of an urban authority under section 157 of the Public Health Act, 1875, and of the London County Council under section 164 of the London Building Act, 1894, shall extend to the making of by-laws requiring the provision in new buildings other than private dwelling houses of such arrangements for heating as are calculated to prevent or reduce the emission of smoke.

Lord NEWTON moved to leave out "other than private dwelling houses." He believed it would be accepted by the Government.

Earl DE LA WARR intimated that this amendment would be accepted.

Lord BANBURY OF SOUTHAM said the result of this would be that, whenever there was a little smoke coming out of a private house, if the cook had allowed some fat to drop in the fire, there would be a visit from an inspector, and probably a fine of half-a-crown or something of that sort. He hoped they were still going to have a little liberty left to them in this country, and appealed for the withdrawal of this amendment, which was really going too far.

Lord NEWTON replied that he had no intention whatever of withdrawing the amendment. He had no doubt Lord Banbury thought it much more economical and desirable that a housemaid should carry a coal scuttle up to the third or fourth floor, rather than there should be a gas-fire. As a matter of fact, that person would not be liable to prosecution, because the amendment only applied to new buildings. All he suggested was that local authorities should be authorized to make by-laws with regard to smoke abatement appliances in new buildings. It was purely optional, and he thought there was no harm in it whatever.

Lord BANBURY: Does this apply only to new buildings?

Lord NEWTON: Yes.

Lord BANBURY remarked that this certainly made a difference. What he felt was that, if he wanted to have a coal fire, there was no reason why he should be told that he must have a gas-fire. They were going back to the days when nobody could do anything at all without the consent of some official.

The amendment was agreed to, as also was a consequential one to insert after "heating" the words "or cooking."

HOUSE OF COMMONS.

Progress of Bills.

Rhymney and Aber Gas Bill: Read the third time, and passed, with amendments.

Manchester Corporation Bill: Read the third time, and passed, with amendments.

Bournemouth Gas and Water Company's Progress.

Interesting and informative, as well as furnishing a study in contrasts, was a gathering which took place, on Aug. 8, in the Town Hall, Bournemouth, in connection with the Bournemouth Gas and Water Company's co-partnership scheme. Mr. William Cash (Chairman of Directors), who presided, spoke of additions to capital during the past 18 months to the extent of £95,000, for development purposes at Poole. He referred to the fact that in the past half-year there had been a remarkable increase in the sale of gas; the figure being no less than 112 million c.ft. As to the excellent results achieved, these were in no small measure due to the energy and ability of Mr. Philip G G. Moon (the General Manager) and his staff. With regard to the working of the co-partnership scheme, the Chairman announced that the bonus now stood at 8¾ p.ct.; a new record had been set up by an increase of over £1000 in the bonus distributed to 635 recipients; and the total sum paid out under this head since 1908 was in the region of £50,000. With regard to the accounts, the withdrawals totalled £869, and there was a balance of £2859 to the credit of co-partners. The pensions fund assets totalled £39,719; and moneys held and invested by the Company amounted to £39,327. An interesting feature of the proceedings was the presentation of medals and certificates to 90 employees who had completed 25 years' service with the Company. One of the recipients was the Chairman himself. In making this presentation, Col. H. W. Woodall mentioned the valuable work which Mr. Cash had accomplished during the past forty years.

Weymouth Consumers' Gas Company.—Highly satisfactory working results are reported by the Directors of the Company for the six months ended June 30. The quantity of gas sold was 432,192 therms, which was larger than that sent out in the corresponding half of 1923 by 10,232 therms—equal to 2·42 p.ct. A reduction of 1d. per therm on the half-year's consumption has benefited the consumers to the extent of £1870. After providing for the interest on the debenture stock, the balance at the credit of the net revenue account is £12,091, out of which the Directors recommend the payment of a dividend on the ordinary stock for the half-year at the maximum rate of 5 p.ct. per annum, less income-tax.

Successful Year at Newcastle (Staffs.).—The annual report of the Gas Committee of the Newcastle (Staffs.) Council was presented at a meeting last week, when Mr. E. Hollins (Chairman) said the past year had been a most successful one for the concern, for, despite several reductions in the price of gas, the profit exceeded that of the previous year by £1200. This was due chiefly to an increased revenue from the sale of residuals, and a reduction in loan charges, owing to an old loan having been paid off. The policy of the Gas Committee, he said, was not to make big profits, but to supply gas at the lowest possible price, and they therefore recommended a further reduction in price to 3s. 6d. per 1000 c.ft. for ordinary meters, and 4s. for slot meters. The net profit was £3331, and it was proposed to spend £1000 of this amount on the renewal of old mains in Liverpool Road, £900 on repairs to a gasholder, and to place £500 to the reserve fund account. Mr. Hollins heartily thanked the Gas Manager (Mr. F. L. Wimhurst) and his staff and workmen for their services during the year, and in doing so pointed out that in about six and a half years' time the whole of the loan charges would be wiped out. It was resolved to grant a bonus of £50 to the Manager for his successful year's work.

MISCELLANEOUS NEWS.

LEEDS GAS UNDERTAKING.

Report of the Year's Working.

The annual report of the Gas Committee for the year ended March 31 shows a gross revenue for the year's working of £797,640, and a gross profit of £187,743. Out of the latter the Committee have to meet loan charges and contributions to capital amounting to £161,794. This leaves a net profit of £25,949, which serves to wipe out the deficit of the previous year, and leave £259 to be transferred to the reserve fund.

The quantity of gas made during the year was 3,151,788,000 c.ft.—an increase of 5·8 p.ct. over the previous year. The yield of gas per ton of coal carbonized is the best in the history of the Department, being 14,319 c.ft., as compared with 13,189 c.ft. during the preceding year—an increase of 8·5 p.ct. The quantity of carburetted water gas produced was 69 million c.ft., compared with 460 millions during the previous year. The gas sold per ton showed an increase of 7·7 p.ct. The total amount of gas sold was 2,964,081,000 c.ft.—a record for the Department, and an increase of 5 p.ct. over last year's figures. The calorific value was 473 B.Th.U. per c.ft.

There was an abnormal demand for coke; the net sum realized being £111,153. The income from tar was £52,428, and from liquor £11,628. The number of gas appliances on hire shows a substantial increase. In the case of gas cookers, for example, while last year the figure was 22,611, the report shows that no less than 24,228 are on hire at the present time. The demand for furnaces for industrial work, having regard to the slackness of trade, has been satisfactory; the number sold being 131, compared with 72 the previous year.

The price of gas during the year has been in accordance with the following scale:

—	To Sept. 30, per 1000 C.Ft.	From Oct. 1, per Therm.
	s. d.	d.
For lighting, cooking, heating, &c.—		
Under 500,000 c.ft.	4 0	10·22
500,000 and under 750,000 c.ft.	3 11	10·00
750,000 ,, 1,000,000 ,,	3 10	9·79
1,000,000 ,, 2,000,000 ,,	3 9	9·58
2,000,000 and upwards	3 8	9·37
For motive power and furnace work—		
Any quantity	3 0	7·66

AIRDRIE GAS DEPARTMENT.

At a recent meeting of the Airdrie Town Council, Mr. A. Kelloch (the Engineer and Manager) submitted his annual report on the year's working of the Gas Department. During the past year, he said, the amount of gas made was 137,100,000 c.ft., as against 129,612,000 c.ft.—an increase of 5·77 p.ct. Coal carbonized amounted to 7486 tons, compared with 6787 tons—an increase of 699 tons on the previous year. The yield of gas per ton of coal carbonized, including water gas from coke and oil, was 18,313 c.ft., as against 19,097 c.ft. The total quantity of gas sold was 131,095,000 c.ft., compared with 122,070,000 c.ft. for the preceding year—an increase of 7·39 p.ct. Both ordinary and prepayment meters showed an increase, while industrial meters consumed 13,696,100 c.ft., compared with 10,923,700 c.ft.—an increase of 25·37 p.ct. The unaccounted-for gas amounted to 4·38 p.ct.

The total income of the undertaking was £36,030, as against £34,361, for the previous year; being an increase of £1669. The gross income from residuals and bye-products amounted to £5835; and after deducting cost of handling and manufacture, the net income from this source was £5032—an increase of £833. The total expenditure under revenue account was £27,287, as compared with £26,191. For manufacture and distribution of gas there was expended £19,278—an increase of £377. The total expenditure under the headings "residual products," "gasfittings," "rates, &c.," "general administration," "sundry expenditure," "discounts and allowances," and bad debts" amounted to £6598. Deducting the total expenditure under revenue account, amounting to £27,287, from the total income, there is a surplus balance of £8743 to be carried to the credit of the net revenue account, to meet the annual standing charges.

The amount at the credit of the net revenue account being £8894 (which is inclusive of a credit balance of £81 brought forward from last year), and the total charges against being £8600, a credit balance of £293 is carried forward to next year.

Maidstone Gas Company.—At the ordinary yearly meeting of the Company, to be held next Thursday, the Directors will present their report for the year ended June 30. The accounts show that after providing for all fixed charges (including £2000 depreciation for stoves and fittings and £1831 for renewal fund) there remains an available balance of £22,212. A dividend is recommended of £8 10s. p.ct., in respect of which an interim dividend at the rate of 4 p.ct. was paid on March 1 last. The sum of £1348 has been transferred to reserve fund. From the meter readings for the September quarter the price of gas was reduced by 0·4d. per therm, from 10·8d. to 10·4d. A further reduction of 0·8d. from the March quarter brought the price down to 9·6d. per therm. The sales of gas show an increase of 72,326 therms—or 3·8 p.ct. over those of the previous year, which in their case also showed a gratifying increase.

THE MOSSLEY GAS ORDER.

An application by the Mossley Corporation for a Special Order under section 10 of the Gas Regulation Act was the subject of a public inquiry at the Offices of the Board of Trade, on Thursday, July 31.

Mr. H. C. HONEY (the Director of Gas Administration) conducted the inquiry; Mr. A. J. Lees (Messrs. Lees & Co., Parliamentary Agents) appeared for the promoters; Mr. G. W. Bailey appeared for the Saddleworth Urban District Council in opposition; and there also appeared in opposition Mr. F. M. Bradbury, Manager of the Una Mills, Ltd. There were present Mr. W. Bennett (Engineer and Manager of the Mossley Corporation Gas-Works); Mr. James Crowther (Town Clerk of Mossley); Mr. H. A. Tanner (Chairman of the Finance and General Purposes Committee of the Saddleworth Urban District Council); and Mr. Rowbotham (Clerk to the Saddleworth Council).

The draft Order consists of 41 clauses, and deals with extension of lands for gas-works purposes, and a number of matters bringing the legislation relating to the undertaking up to date.

Mr. A. J. LEES (Parliamentary Agent), for the Mossley Corporation, said the promoters were the owners of a gas undertaking which now supplied the Borough of Mossley and the districts of Saddleworth and Springhead. Originally the undertaking belonged to the Stalybridge Gas Company, which obtained an Act of Parliament in 1855 authorizing the supply of gas in the boroughs of Mossley and Stalybridge and the then parish of Saddleworth. These gas-works, now in the hands of the Mossley Corporation, were situated close to the Una Mills, one of the opponents, and these mills had worked next to the gas-works for the past 50 or 60 years. In 1885, an Act of Parliament was passed under which the undertaking was taken over by the Stalybridge and Mossley Corporations as regards their respective areas. Section 28 of that Act, which applied to both the Stalybridge and the Mossley Corporations—though there were now two undertakings—related to the establishment of an insurance fund, concerning which there was now some opposition by the Saddleworth Council. Under the 1885 Act the insurance fund could amount to 5 p.ct. of the total amount of money borrowed for the purpose of the undertaking (otherwise the capital expenditure), but there was no limitation on the amount which could be set aside annually to the fund—always, of course, with the total limitation of 5 p.ct. This fund was to meet extraordinary claims in respect of the undertaking which, in the opinion of Justices, due care and management could not prevent. Under section 29 of the 1885 Act, a standard price was imposed of 3s. per 1000 c.ft. in Mossley, with a differential of 2d. in the remaining district served by Mossley, including Saddleworth. This Mr. Lees believed to be the only case of a Corporation gas undertaking having what corresponded to a sliding-scale. One other matter referred to was that under the Act of 1885 the No. 2 Metropolitan burner was cited as the test for ensuring that 16 c.p. gas was supplied.

These, continued Mr. Lees, were the conditions under which the Mossley undertaking had been carried on since 1885 until the passing of the Gas Regulation Act of 1920. After the passing of the latter, the Mossley Corporation applied for two Orders under section 1 (power to charge on the therm basis) and section 10 (which empowers the Board of Trade to make Special Orders). Under the section 1 application it was sought to change the standard price from 3s. and 3s. 2d. to 15d. and 16d. per therm respectively, while under the section 10 application it was asked that the total amount of the insurance fund should be increased from the 5 p.ct. already mentioned to 12½ p.ct. (which would have brought the fund up to £17,500), to institute a renewals fund of £20,000, and to increase the carry-forward from £2000 to £4000. There had evidently been some miscalculation, because the effect of the proposed therm price would have been to increase the differential in Saddleworth and Springhead to the equivalent of 5d. per 1000 c.ft., instead of the existing 2d. Under the section 10 Order, also, power was taken to acquire additional lands to the east and south-west of the existing site, for which a provisional contract to purchase had been negotiated. However, objection was taken to the form of these two applications, and the Orders were not proceeded with. Subsequently, it was realized by the Mossley Corporation that their powers would have to be amended in some form; and on July 16, 1923, a meeting took place with representatives of the Saddleworth Council, and a statement of the amendments of the Act of 1885 proposed to be asked for was placed before them. Under these amendments it was also proposed to institute a special purposes fund, in place of the insurance fund, to meet extraordinary expenses incurred in respect of strikes or circumstances which due care and management could not prevent, and in respect of replacement or renewal of plant other than expenses requisite for the maintenance of plant and works. This was to be maintained at the rate of 1 p.ct. per annum with a limit of 10 p.ct. of the total moneys borrowed. It had since been proposed that a renewal fund should be maintained by an amount equal to 1 p.ct. per annum of the money borrowed in respect of the undertaking, with a limit of 5 p.ct. of the money borrowed. This was for the purpose of the maintenance and renewal of plant. There was also a reference to the new lands, to the repeal of the section of the 1885 Act relating to discounts to large consumers, and other minor matters. The Finance and General Purposes Committee of the Corporation—which was a Committee of the whole Corporation—passed a resolution in September, 1923, advising the Council not to oppose these amendments, though it was stated during the discussions that it was the 2d. differential which was causing the Saddleworth Council some doubt.

Mr. Lees said that on the strength of the resolution and the letter the Corporation—believing that Saddleworth agreed—proceeded with their application for the present Special Order under section 10; and, the negotiations for the land having been completed on Feb. 22, 1923, the Order was applied for on April 9, 1924, the negotiations with Saddleworth, of course, having taken place between these two dates. It was, therefore, with some surprise that they learned of the opposition of the Saddleworth Council.

Dealing with the present position of the Mossley undertaking, Mr. Lees said that the capital expenditure to date was, in round figures,

£144,000, and the quantity of gas sold for the year ended March 31 was 174 million c.ft., of which 50 million c.ft. was sold to prepayment consumers. Referring briefly to the most contentious clauses of the present draft Order, he pointed out that clause 25, the special purposes fund—in the terms already placed before the Saddleworth Council and assumed to be agreed—was the Model Bill Clause, as was clause 26, the renewals fund. The object was to prevent a heavy demand upon the undertaking for renewals in one year; in other words, to be able to spread the expenditure evenly each year by making use of the renewals fund. Otherwise, it would be necessary to increase the price of gas in years when expenditure on renewals was high, and to reduce it on other years—a proceeding undesirable in the interests of the consumers, who naturally preferred the price of gas to be maintained uniformly. Among the other objections of the Saddleworth Council was the one that the old Act of the Mossley Corporation should be repealed; but they overlooked the fact that the 1885 Act applied to both the Stalybridge and the Mossley Corporations, though they now had separate undertakings. Then it was said that, as Saddleworth took more gas than Mossley, these new powers should not be granted, as they gave benefits to Mossley which were not shared by the outside districts. Mr. Lees said that he did not know what this meant, because at present Mossley took more gas than Saddleworth. Then there was an objection to the differential; the assumption being that it cost no more to supply in Saddleworth than in Mossley. His evidence, however, would show that this was not the fact. Then as regards clause 13, to which objection was also made, this related to specifications for pipes and fittings; but in the case of the Watford Order the Board of Trade had inserted this clause, though it was not proposed by the promoters in that case. The clause relating to insufficiency of mains was held-over pending a decision in the Pinner case. Saddleworth also objected to the repeal of section 30 of the Act of 1885 (discount to large consumers), though the Finance and General Purposes Committee had apparently agreed to it in September, 1923. It was also asked that all reasonable extensions of mains outside Mossley should be carried out without requiring a guarantee as at present; that all the main roads in Saddleworth ought to lighted by gas; that the Mossley Corporation should come under the Gas Regulation Act as regards pressure, and, finally, that the Saddleworth Council should have some representation on the management of the gas undertaking. There was no precedent for the latter, said Mr. Lees, in the case of any undertaking, except the Manchester Ship Canal, upon which the Manchester Corporation was represented.

Coming to the only other opposition—the railway companies had entered notice of objection, but did not appear—Counsel repeated what he had said earlier about the Una Mill, the owners of which objected to the new lands being used for gas-works purposes, on the grounds of obstruction of light and smell. The works had been on the same site for 60 years, and the new land was on the other side of the canal, so that he could not imagine that any inconvenience would be caused, while there was always a remedy at common law. Moreover, the mill was destroyed some 40 or 50 years ago, and presumably the owners had the insurance money. They could have gone to another site; but instead of doing that, they rebuilt the mill on the old site.

Mr. *W. Bennett* (Engineer and Manager of the Mossley Corporation Gas Department) said that in 1887, the first year of the working of the undertaking, the gas sold in Mossley was 36 million c.ft., while 24 million c.ft. were sold outside. For the year ended March 31, 1924, the amount sold in Mossley was nearly 88 million c.ft., and outside 116,629 c.ft., of which, however, 15 million c.ft. were sold to one special consumer in Saddleworth. The amount used on the works was 2½ million c.ft. One of the reasons why there had been a greater increase in the sale of gas in Saddleworth than in Mossley was the competition in Mossley of the Stalybridge, Hyde, Mossley, and Dukinfield Electricity Joint Board, which was not operating in Saddleworth. That was the position until a year ago; but the Joint Electricity Board had been authorized to extend its area to include Saddleworth, and mains were being laid for this purpose, so that he anticipated a certain falling-off the supply of gas in Saddleworth—to begin with, at any rate.

The question of borrowing powers was then mentioned, but Mr. HONEY pointed out that as no specific sum was mentioned in the Order, and this matter would be dealt with by the Ministry of Health when the time came, it was not worth while dealing with it then.

Witness, continuing his evidence, then dealt with the suggestion that it cost no more to supply in Saddleworth than in Mossley. He said there were 19 miles of mains in Mossley and 32 outside. The outside districts were of a straggling nature, and Saddleworth consisted of six villages, all some miles apart, while a great deal was moorland. An electric cable was now being laid for the use of the one large consumer in Saddleworth who last year took 15 million c.ft. of gas. The sale per mile of main in Mossley was 4,100,000 c.ft., while in the outside districts this figure was 3,130,000 c.ft. The gas unaccounted for was 21 million c.ft. over the whole area, and on the basis of the consumption per mile already given, this gave 7,716,000 c.ft. unaccounted for in Mossley and 13,097,000 c.ft. in the outside districts. This, however, was not all, because the figure assumed an average unaccounted-for loss per mile of main, irrespective of altitude. Whereas the altitude of the gas-works above sea-level was 478 ft., the mains in Saddleworth reached an altitude of 1005 ft. above sea-level at a spot 7 miles from the works, so that the average altitude of the mains outside was much greater than that in Mossley. Moreover, it must be remembered that leakage varied directly as the square root of the pressure; and as the great difference in altitude had the effect of increasing the required pressure in parts of the outside districts by some 200 p.ct., this necessarily increased the proportion of leakage in the mains outside Mossley. On this basis the figures showed a leakage loss of 9 p.ct. in Mossley, and 11·48 p.ct. in the outside districts. Even if the leakage were the same percentage outside as inside Mossley, then the quantity of gas required to be sent into the outside districts to give the same service as that demanded in the year 1923-4 would have been 110 million c.ft. instead of the 114 million c.ft. actually supplied. The net cost of production last year into the holder was 17·578d. per 1000 c.ft., so that the extra cost of this 4 million c.ft. was £228, or 0·542d. per 1000 c.ft. It was estimated that the net cost of production during the current year would be 21·95d. per 1000 c.ft., and taking the same figures of extra gas required in Saddleworth on account of the higher pressure, the increased cost would be £285, or 0·677d. per 1000 c.ft. Again, as more than half the quantity of the gas consumed in the outside districts was used at a distance greater than 2½ miles from the works, it followed that the cost of collecting from prepayment meters, and reading ordinary meters, as well as attending to complaints and general maintenance, was much greater per 1000 c.ft. there than in Mossley. A pressure of 5 lbs. had to be maintained to get the supply to the farthest point, and this involved compressing plant which at present was air cooled; there being two compressors capable of dealing each with 30,000 c.ft. of gas per hour. New water-cooled compressors would be required if the demand continued to increase, or a new holder would have to be erected in Saddleworth. This extra cost of compressing the gas for Saddleworth amounted to 1·828d. per 1000 c.ft., or almost the 2d. differential. In addition, however, there was the extra cost of inspection, mains and services, repairs, &c.; and the final figures were arrived at as follows: Loss due to extra unaccounted-for gas, 0·677d.; loss due to extra maintenance, 1·356d.; and loss due to having to compress the gas, 1·828d. The total, 3·861d., was nearly double the present differential, and there was actually a loss of 1·861d. per 1000 c.ft. on the gas supplied in Saddleworth, which represented £783 per annum. Yet Saddleworth were asking that the 2d. differential should be knocked off. As to the renewals fund, there was at present 62 p.ct. of the plant to be replaced, and this would have to be taken out of revenue during the years of replacement unless a renewals fund was formed. Objection had also been taken to clause 17, the stand-by clause, which provided for the payment by the consumer of a reasonable sum, to cover the expenses of the Gas Department, where the consumer had a separate supply; and failing agreement, there was to be arbitration. This was the same clause as applied to electricity supply.

Mr. BAILEY said that Saddleworth objected to sending every small consumer to arbitration, and preferred that a fixed charge of (say) 25s. per quarter should be inserted. That would get over the trouble from the point of view of Saddleworth.

In the course of his cross-examination, Counsel put it that there was no case of a municipal gas-works having a special purposes fund as well as a renewals fund.

Counsel questioned witness at some length as to the uses to which the special purposes and renewal funds would be applied, his object being to show that there was no necessity for the special purposes fund to be created in place of the insurance fund, and for a renewal fund as well. In the course of his replies, witness said that 5 p.ct. of the net indebtedness of the Corporation in respect of the undertaking would only provide sufficient to deal with charges likely to fall on the fund as an insurance fund; but if it were to be a special purposes fund, then its scope would be enlarged, and it followed that the fund must be larger. As to the renewals fund, this would be used to meet repairs which could not be charged to revenue—for instance, the re-sheeting of a gasholder.

With regard to the stand-by clause, which provided that a person receiving a stand-by supply should pay a minimum annual sum which would give the Corporation a reasonable return on the capital expended in providing that supply, Counsel suggested that there should be a maximum charge of (say) 25s. per quarter, but witness considered that each case should be dealt with on its merits.

As to the Corporation's application to repeal the section of their 1885 Act which provided for a discount to consumers of large quantities of gas, Counsel objected to the rights of such consumers being taken away, and said that the consumers would be at the mercy of the Corporation. Witness's reply was that the Corporation did not contemplate taking away these discounts; the policy would be rather to increase them, but they should not be tied down as at present in this respect. They had to compete with electricity.

As to representation of the Saddleworth Council on the Corporation's Gas Committee, witness said that the Corporation objected to any one who was not a representative of the ratepayers of Mossley taking part in the deliberations of the Gas Committee. He would undertake, however, to attend all the meetings of the Saddleworth Lighting Committee and to give all the information in regard to the gas undertaking that it was essential the Saddleworth Council should have.

This closed the case for the promoters.

Mr. BAILEY, addressing Mr. Honey on behalf of the Saddleworth Urban District Council, pointed out that they did not wish to place any difficulties in the way of the proper development of the Mossley Corporation; they wished to live on terms of the utmost amity with their neighbours, and merely wanted to set matters right which from their point of view were wrong. He was surprised that the promoters did not accept with alacrity the suggestion that the very old provisions under which they were working should be scheduled to the Order in a consolidated form.

Mr. HONEY, in the course of discussion on this point, agreed that it was desirable that powers should be brought up to date and consolidated, but he did not think the Board of Trade could do that in every case. The Board were not particularly impressed in this particular instance.

Mr. BAILEY then put forward his arguments that the Corporation, by seeking two funds, were asking for double the powers ordinarily obtained by Corporations, and that there was no necessity for the two. He objected to the repeal of the Corporation's obligation to supply large consumers at a discount.

Counsel, dealing further with the two funds asked for in the Order, said there were no precedents for the granting of those powers, and he did not think they had been asked for before. There should be one reserve fund to cover all the matters to be included in the two funds asked for by the Corporation, and the maximum amount should be 10 p.ct. of the present outstanding debt on the undertaking.

Mr. *George Evetts* (Consulting Engineer), in evidence for the Saddleworth Council, said that up to March, 1923, £64,665 had been provided for sinking fund charges, out of total borrowings of £139,050—that was 46½ p.ct. The repayments were statutory ones, and no com-

plaints could be made. It was admitted that the loans raised by the gas undertaking were raised on the credit of the Mossley Corporation; but, on the other hand, deficiencies could always be met by an increase in the price of gas, and the undertaking need never burden the rates. Consequently, the liability of the Mossley ratepayers was practically negligible. As to the differential price (which had been in operation for nearly 40 years) on the basis of consuming nearly 50 p.ct. of the gas sold during this period, Saddleworth had contributed upwards of £17,000 by way of differential charge. There was no doubt that Saddleworth was a more expensive district to supply than was Mossley, but he could not accept the figures put forward to show that the Corporation had actually made a loss on the 2d. differential. With regard to the special purposes fund, this was intended to be a company provision only, because local authorities had a reserve fund which covered the purposes for which the special purposes and renewal funds of companies were applicable. Interest and sinking fund charges at Mossley amounted to about 9·9d. per 1000 c.ft. Of that, sinking fund charges represented about 5·4d. The yearly payments which could be made to the two funds asked for in the Order represented 4d. per 1000 c.ft., which, when added to the 5·4d., would result in a charge of 9·4d. per 1000 c.ft. for renewals and emergencies over and above the actual cost of maintenance and ordinary repair of the undertaking. He considered that was too much.

Asked by Counsel if he agreed that the amount of the special purposes fund should be based, not on the total expenditure, but on the debt outstanding, Mr. Evetts said that if the amount were limited to 10 p.ct., he saw no objection to basing that on the total capital expenditure, because it was the total capital expenditure which defined the magnitude of an undertaking.

Mr. *H. A. Tanner* (Chairman, Finance Committee, Saddleworth Urban District Council) was called to give evidence as to the events leading up to the opposition of the Council to the proposals of the Order.

Mr. LEES objected to the evidence, because Mr. Tanner was not present at the meeting when it was decided not to oppose.

Mr. HONEY, interposing, said it seemed monstrous that a resolution should be passed by the Council, stating that they did not intend to oppose, and that a letter should be written subsequently which did not in terms carry out that resolution.

It was decided that witness should be allowed to state why he was opposing the proposals on this occasion. His evidence was to the effect that the quantum of the funds proposed to be created was objected to. Under the proposals in the Order, the amount appropriated per annum would be about £21,000, whereas 10 p.ct. on the outstanding debt, as proposed by Saddleworth, would be about £7000.

Mr. *F. M. Bradbury* (Manager of the Una Mill) then put forward his complaint that the erection of gas-works on the proposed land would affect the health of the workpeople at the mill, by reason of the smoke and fumes emitted. There were gas-works on two sides of the mill already, and if the new works were erected on the land proposed, the mill would be enclosed on three sides by gas-works. It was true that he could obtain an injunction against the gas undertaking if there were a nuisance, but he wished to avoid an expensive lawsuit if possible. He asked for a guarantee, or a clause inserted in the Order, that the business of the mill should not be interfered with in any way.

Mr. LEES, replying on behalf of the Mossley Corporation, said that the mill had been situated near the existing gas-works for 60 years, and he was not aware of any difficulty having been experienced. If, however, they committed a nuisance in the future, the mill owners had their remedy. There had been no nuisance in the past, and it need not be anticipated in the future. The proposed additional works would be farther from the mill than the works with which they had lived for 60 years. The Gas-Works Clauses Act included provisions that gas-works should not interfere with other businesses.

TRADE NOTES.

"Withstanding Temperature and Time."

This is the title of an illustrated pamphlet published by Messrs. Drakes Limited, of Halifax, in which is some remarkable evidence of the durability of their well-known settings.

Neutralizing Sulphate of Ammonia.

Messrs. Hooper and Weyman, of Pilgrim House, Newcastle-on-Tyne, have designed a special plant for neutralizing sulphate of ammonia by the process evolved by Dr. G. Weyman, particularly suitable for the requirements of small works. In an informative pamphlet recently published by the firm, the advantages of the system are well set out; and those interested cannot do better than write to the makers for further particulars.

Power-Gas Corporation, Ltd.

This firm have recently secured many noteworthy contracts. Among them we notice a coal-gas retort generator plant with direct bye-product recovery for the Yokohama Gas-Works. The initial plant has a capacity of one million c.ft. a day, and is laid-out suitable for extension to three times this output. It comprises two generators with mechanical fuel feed and coke extractor gear, waste-heat boiler, ammonia absorber, gas washer, blowers, &c. Another contract is for the Bwana M'Kuba Copper Mining Company, Ltd.; and the plant is to be erected in Northern Rhodesia. It includes low-temperature recovery gas-producer plant, six gas-engine driven electric generators, two steam-driven dynamos, and switchboard and cable equipment.

Nottingham Gas Undertaking.—Considerable interest attaches to the arrangements which have been made for the celebration at Nottingham, on Thursday next, of the Jubilee of the acquisition of the gas undertaking by the Corporation on Aug. 14, 1874. In connection with Thursday's commemoration, visits have been arranged to the Radford and Basford carbonizing stations, followed by a luncheon at the Exchange Hall, where a dinner is also to be given by the Gas Committee on the evening of the same day.

THE NORTH-EAST COAST COAL TRADE.

From our Own Correspondent.

Conditions on the market remain very much the same, and it is difficult to find evidence on 'Change of the improved tone which sections of the Daily Press claim to have noticed in the past fortnight or so. The best that can be said, on the whole, is that quotations have not shown any further decline. But this is rather because prices have reached the rock-bottom possible in comparison with current production costs, than that they are attracting any appreciably greater volume of trade. Many collieries are working very short time, but still the supply appears to be quite adequate to meet the demand.

Best Northumberland steams and best Durham gas makes are the only sections to show any firmness at all. Coking coals and inferior gas makes are very weak. Wear Special makes quote about 22s. 6d. f.o.b., and best qualities (Holmside, Boldon, New Pelton class), 22s. Seconds and others are obtainable at 18s. 6d. to 20s.

YORKSHIRE AND LANCASHIRE COAL TRADE.

From our Local Correspondent.

The situation in the coal trade in Yorkshire and Lancashire has undergone very little change during the past week. If anything, there is a slightly better undertone. Apart from holidays, the collieries are working rather better, and may be working five days this week. The demand for domestic coal has somewhat improved, and stocks at the collieries have been considerably reduced.

Gas coal is only in moderate demand—a usual feature at this time of the year—but even in this section of the trade there are signs of awakening. Gas undertakings are taking advantage of the cheaper spot lots, and are putting into store for winter use. Gas coke is exceptionally scarce, and commands approximately 36s. per ton f.o.b. for the small quantity available for export. There are prospects of a great scarcity during the coming winter.

Inquiries for export are a little more numerous, particularly in steam coal. For Yorkshire or Midland gas coals for export, inquiries are very meagre indeed. A generally increased demand for Durham gas coal may now be expected. Prices for all qualities of coal remain approximately as last week; but there may be an upward tendency in the near future.

In Lancashire, the competition of the cheap coal from Derbyshire and Yorkshire mines is decreasing. Colliery prices remain as they were. Prices at Hull at the week-end were:—Bunkers: Yorks, Derby, and Notts large screened steam, f.o.b. Humber ports, 20s. to 20s. 6d. per ton. Cargo for export, f.o.b. usual shipping ports: Best Yorks hards, association, 23s. 6d.; Derby best hards, 23s. to 24s. 6d.; best Yorks Hartleys, 20s. to 22s.; South Yorks washed doubles, 20s.; South Yorks washed singles, 19s. 6d.; dry doubles, 16s. to 17s.; South Yorks washed smalls, 15s. 9d. to 16s.; Derby slack, 1 in., 13s. 9d.; South Yorks rough slack, 14s. 3d.; gas coke, 34s. 6d. to 37s.; foundry furnace coke, 26s. 3d. to 27s.; washed smithy peas, 21s. 6d. to 26s. 6d.; washed steam thirds, 19s. 9d.; South Yorks washed trebles, 21s. 6d. per ton.

COAL TRADE IN THE MIDLANDS.

From our Local Correspondent.

This has been practically a blank week in the Midland coalfields. A restart was made at some collieries on Thursday, but little coal was got up, and work will not be general before Monday. Deliveries of industrials have been suspended, and there are sufficient stocks for the resumption next week. Slacks and D.S. nuts are in abundant supply, and are difficult to dispose of. The only semblance of activity is in house coal for stocking; and the tendency is for prices of these to harden, to the extent at least of the modification, or in some cases the withdrawal, of special concessions.

CURRENT SALES OF GAS PRODUCTS.

The London Market for Tar, Tar Products, and Sulphate.

LONDON, *Aug.* 11.

The London tar products market naturally is quiet at this season. In the absence of material business, the price for pitch remains nominally at 60s. net per ton f.o.b. at makers' works, with creosote at 6¼d. to 6⅜d. per gallon net in bulk *ex* works. Other products are also unchanged.

Tar Products in the Provinces.

Aug. 11.

The markets for tar products have remained quiet throughout the past week, and there is little or no alteration in the values.

The average values for gas-works products during last week were: Gas-works coal tar, 42s. to 47s. Pitch, East Coast, 55s. to 57s. 6d. f.o.b. West Coast—Manchester, 50s. to 52s. 6d.; Liverpool, 51s. to 52s. 6d.; Clyde, 52s. to 55s. Benzole 90 p.ct., North, 1s. 5d. to 1s. 6d.; crude 65 p.ct. at 120° C., 1s. to 1s. 1d. naked at makers' works; 50-90 p.ct., naked, North, 1s. 8d. to 1s. 10d. Toluole, naked, North, 1s. 5d. to 1s. 6d., nominal. Coal tar crude naphtha in bulk, North, 7¼d. to 8d. Solvent naphtha, naked, North, 1s. 4d. to 1s. 5d. Heavy naphtha, North, 1s. 2d. to 1s. 3d. Creosote, in bulk, North, liquid, 6d. to 6½d.; salty, 5½d. to 5⅝d.; Scotland, 5½d. to 5⅝d. Heavy oils, in bulk, North, 9d. to 9½d. Carbolic acid, 60 p.ct., 1s. 10d. to 1s. 11d. prompt. Naphthalene, £15 to £16; salts, £6 to £8, bags included. Anthracene, "A" quality, 4d. per minimum 40 p.ct., purely nominal; "B" unsaleable.

STOCK MARKET REPORT.

The holiday depression had disappeared when the Stock Exchange opened on Tuesday. The invitation to the German delegates to participate in the London Conference was immediately accepted, and simultaneously a marked improvement occurred in the exchanges, particularly sterling. Business was stimulated, and what must be described as a gamble sprung up in the various German Loans. The fact that a settlement of this difficult question was at last within the bounds of possibility apparently aroused hopes that there will in the future be some value in these, at present, worthless securities. French Bonds and Rentes, and in fact most Foreign Government securities, participated in the upward movement.

The market for gilt-edged stocks is showing a better tendency; but the future is by no means certain. Colonial stocks were in some instances stronger. A good purchase is the short-dated Queensland 5½ p.ct. 1926 29 stock at 100½.

Industrials were irregular; but Iron and Steel shares, after a long period of depression, showed improvement on the prospects of an industrial revival.

There is little to record in the Gas Market. The South Suburban dividend for the half-year at 6½ p.ct. per annum shows a rise of ½ p.ct. on the rate paid for the corresponding period last year, and the Croydon dividends show no change at 6½ p.ct. per annum on the sliding-scale stock and 5 p.ct. per annum on the maximum dividend stock. It will be seen by the table that there has been little change in the quotations.

The following transactions were recorded during the week:

On Tuesday, Alliance and Dublin 64½, 65½, Bombay 5 5/16, 5½, Brentford "A" 105, 105½, 106, "B" 104½, 105, Brighton and Hove 174, Commercial 4 p.ct. 89½ *ex* div., European 7⅜ *ex* div., Gas Light and Coke 93, 93⅛, 93¼, 93⅜, 93½, 3½ p.ct. maximum 63¾, Imperial Continental 165½, 166⅛, Primitiva 6s. 1½d., 6s. 7½d., South Metropolitan 99⅝, 3 p.ct. debenture 61. Supplementary prices, Aldershot new "C" 82¾, 83.

On Wednesday, Brentford "A" 105, "B" 104½, 105, Brighton and Hove "A" 127½, British 117, Gas Light 93, 3½ p.ct. maximum 63⅛, Imperial Continental 167, Montevideo 56½, 57, Primitiva 6s. 9d., South Metropolitan 99⅜, 6½ p.ct. debenture 104⅜. Supplementary prices, Aldershot 5 p.ct. "C" 82⅜, 83½, Lea Bridge 7 p.ct. debenture 103¾.

On Thursday, Brentford "A" 105, 106, "B" 105, Brighton and Hove "A" 128, European 7 5/16 *ex* div., Gas Light and Coke 92¾, 93, 93½, 4 p.ct. preference 80½, 3 p.ct. debenture 61½, 62, Imperial Continental 165, 166, 167, Montevideo 56, Newcastle 82 *ex* div., Primitiva 6s. 9d., South Metropolitan 99⅜, 100¼, 6½ p.ct. debenture 104⅜, South Suburban 5 p.ct. debenture 97½, Tottenham "A" 117½, 118 *ex* div., "B" 100 *ex* div., Wandsworth (Wimbledon stock) 111½. Supplementary prices, Danish 65s., 66s. 3d., 5 p.ct. preference 5⅞, 6.

On Friday, Alliance and Dublin 64¾, Commercial 3½ p.ct. 89 *ex* div., Continental Union 20½, European 7 13/16 *ex* div., Gas Light and Coke 92½, 92⅝, 93½, 3 p.ct. debenture 61½, Imperial Continental 3½ p.ct. debenture 71½, Newcastle 82½ *ex* div., Portsea Island "B" 104, "C" 100, South Metropolitan 98½, 99⅜, 100¼, 100½, South Suburban 5 p.ct. debenture 95, Southampton 87, Tottenham 4 p.ct. debenture 77, 78. Supplementary prices, Liverpool 5 p.ct. 92, Southend-on-Sea 5 p.ct. new "B" 84⅜.

The Money Market was not affected by the reduction in the New York Federal Reserve Bank rediscount rate and the strength of the dollar-sterling. Treasury Bills were allotted at the high average rate of £3 15s. 4·22d p.ct. —a rise of nearly 2s. on last week's rate. This rate is the highest since November, 1921, and opinions have been expressed that, had it not been for special monetary assistance, the average rate would have been nearer 4 p.ct.

On both sides of the Atlantic monetary conditions moved in favour of a rise in the American value of sterling. The reduction in the New York rediscount rate to 3 p.ct. created a big demand. The price of the pound touched 4·54⅜—the highest for about two months. Profit-taking brought about a relapse; and the price closed at 4·52⅜. French francs fluctuated during the week and closed at 81·35, Belgian francs at 89⅛, and Italian lire at 100⅜. The Dutch exchange was very active, rising to 11·64 at the end of the week.

The price of silver closed at 34⅜d. per oz.; the market being dull on American selling.

The Bank rate is 4 p.ct., to which it was raised from 3 p.ct. on July 5, 1923. Bankers' deposit rates are 2 p.ct. The deposit rates of the discount houses are 2 p.ct. at call and 2½ p.ct. at notice.

Issue.	Share.	When ex-Dividend.	Dividends. Prev. Hf.Yr.	Dividends. Last Hf. Yr.	NAME.	Quotations. Aug 8.	Rise + or Fall − on Week.	Transaction Lowest and Highest Prices.
£			%p.a.	%p.a.				
131,978	Stk.	Feb. 7	5	5	Aldershot 5 p.c. max. C.	81—84	..	..
235,492	,,	,,	4	4	Do. 4 p.c. Pref.	70—73	..	..
1,551,868	,,	Apr. 3	5½	6	Alliance & Dublin Ord.	63—68	..	64½—65½
374,000	,,	July 10	4	4	Do. 4 p.c. Deb.	60—65	..	..
280,000	5	May 22	8	8	Bombay, Ltd.	5—5⅛	..	5 5/16—5½
100,000	10	Mar. 6	8½	8½	Bournemouth 5 p.c.	12½—13½	..	..
383,110	10	,,	7	7	Do. B 7 p.c..	12—13	..	..
150,000	10	,,	6	6	Do. Pref. 6 p.c..	11—12	..	..
50,000	Stk.	June 26	3	3	Do. 3 p.c. Deb..	54—59	..	..
162,025	,,	,,	4	4	Do. 4 p.c. Deb..	74—79	..	..
992,045	,,	July 10	6 1/16	6 1/16	Brentford A Con.	104—107	+1	105—106
990,500	,,	,,	6⅛	6⅛	Do. B New	104—107	+1	104½—105
96,000	,,	,,	5	5	Do. 5 p.c. Pref.	87—92	..	..
306,690	,,	June 12	4	4	Do. 4 p.c. Deb.	75—80	..	..
181,337	,,	,,	—	6	Do. 6 p.c. Rich. Red. Deb.	100—105	..	..
214,740	,,	Mar. 6	13½	8½	Brighton & Hove Orig.	171—176	..	174
244,200	,,	,,	8	8	Do. A Ord.	126—129	..	127½—128
1,287,500	,,	July 24	5	5	Bristol 5 p.c. max.	91—92*a	..	..
855,000	,,	Mar. 20	—	7	British Ord.	117—122	..	117
100,000	,,	June 26	7	7	Do. 7 p.c. Pref.	118—123	..	..
120,000	10	,,	4	4	Do. 4 p.c. Red. Deb.	72—77	..	..
100,000	10	May 22	6	8	Cape Town, Ltd.	6½—7½	..	..
150,000	10	Apr. 24	4½	4½	Do. 4½ p.c. Pref.	6—7	..	..
100,000	Stk.	June 26	4½	6	Do. 4½ p.c. Deb.	71—76	..	..
626,860	,,	July 24	6	7½	Cardiff Con. Ord.	97—100*	..	..
237,860	,,	June 26	7½	6½	Do. 7½ p.c. Red. Deb.	101—106	..	..
157,150	,,	Mar. 6	5	6	Chester 5 p.c. Ord.	88—93b	..	89½
1,513,280	,,	July 24	6	6	Commercial 4 p.c. Cap.	88—93	..	89
560,000	,,	,,	6	6	Do. 3½ p.c. Cap.	88—93*	..	..
475,000	,,	June 12	3	3	Do. 3 p.c. Deb.	56—59	..	29½
800,000	,,	14 Jan. 15	—	—	Continental Union, Ltd.	27—32	..	..
200,000	,,	June 12	7	7	Do. 7 p.c. Pref.	77—82	..	..
660,000	,,	Mar. 6	6½	6½	Croydon sliding scale	101—104	..	..
284,975	,,	,,	5	5	Do. max. div.	85—89	..	..
492,270	,,	Feb. 21	3	4½	Derby Con.	108—110c	..	..
55,000	,,	July 10	4	4	Do. Deb.	74—76c	..	..
209,000	,,	Apr. 3	5	5	East Hull 5 p.c. max.	..	..	..
1,002,180	10	July 24	2	6	European, Ltd.	7½—8½*	..	7½—7 13/16
16,503,045	Stk.	Feb. 7	5½	5½	Gas Light & Coke 4 p.c. Ord.	92—94	..	92½—93½
2,600,000	,,	,,	3½	3½	Do. 3½ p.c. max.	62—65	..	63½
4,062,235	,,	,,	4	4	Do. 4 p.c. Con. Pref.	80—83	..	80½
4,761,930	,,	June 12	3	3	Do. 3 p.c. Con. Deb.	61—64	..	61⅛—62
130,000	,,	—	10	10	Do. 10 p.c. Bonds	..	..	..
42,000	,,	,,	7½	7½	Do. 7½ p.c. Ilford Deb.	..	..	..
82,500	,,	Mar. 20	6½	6½	Hastings & St. L. 5 p.c. Conv.	91—96	..	..
258,740	,,	,,	5½	5½	Do. 3½ p.c. Conv.	76—81	..	..
70,000	10	May 8	10	10	Hongkong & China, Ltd.	16—17	..	..
86,600	Stk.	Mar. 6	9½	10	Hornsey 7 p.c.	143—148	..	165—167
1,976,000	,,	May 22	10	30	Imperial Continental Cap.	165—170	..	71½
263,950	,,	Feb. 7	3½	3½	Do. 3½ p.c. Red. Deb.	69—72	..	..
235,242	,,	Mar. 6	6½	6½	Lea Bridge 5 p.c. Ord..	97—102	..	..
2,127,340	,,	Feb. 21	5½	5½	Liverpool 5 p.c. Ord.	91—92b	+½	..
600,000	,,	Mar. 20	7	7	Do. 7 p.c. Red. Pref.	103—106b	..	..
165,736	,,	Feb. 21	9	8	Maidstone 5 p.c. Cap.	124—129	..	..
63,480	,,	June 26	3	3	Do. 3 p.c. Deb.	53—58	..	..
75,000	5	,,	5	7	Malta & Mediterranean	34—34	..	..
341,920	Stk.	June 12	4	4	Montevideo, Ltd.	54—59	..	56—57
1,875,892	,,	July 24	5½	5	Newcastle & Gateshead Con.	82½—83½*d	—½	82—83
250,166	,,	,,	4	4	Do. 4 p.c. Pref..	74—75*d	+½	..
329,705	,,	June 26	3½	3½	Do. 3½ p.c. Deb.	70—72	..	..
15,000	10	Mar. 6	11	11	North Middlesex 10 p.c.	16—17	..	..
75,940	10	,,	7 7/16	7 7/16	Do. 7 p.c.	11½—12	..	..
300,000	Stk.	May 8	9	7	Oriental, Ltd.	98—101	..	..
138,120	,,	June 26	7⅞	7½	Plym'th & Ston'house 5 p.c.	112—117	..	104
60,000	50	Mar. 6	13	13	Portsea Island B	102—105	..	100
100,000	50	,,	12	12	Do. C	98—103	..	6/1½—6/9
2,289,909	1	—	—	—	Primitiva Ord.	⅛—⅜	..	..
341,400	100	June 2	4	4	Do. 4 p.c. Red. Deb..	74—77	..	..
600,000	Stk.	July 24	4	4	Do. 4 p.c. Red. Deb. 1911	53—56*	..	..
220,335	,,	June 26	4	4	Do. B. Aires 4 p.c. Rd. Db.	54—57	..	..
321,670	,,	,,	4	6	Do. R'r P'te 4 p.c. Rd. Db.	54—57	..	..
150,000	10	Mar. 20	6	5	San Paulo 6 p.c. Pref.	7—7½	..	..
125,000	50	July 1	5	5	Do. 5 p.c. Red. Deb.	41—43	..	..
270,000	Stk.	Mar. 20	5	5/8/4	Sheffield A	99—101e	..	..
419,968	,,	,,	5	5/8/4	Do. B	99—101e	..	..
1,047,000	,,	,,	5	5/8/4	Do. C	99—101e	..	..
90,000	10	June 12	6	8	South African	7—9	..	..
6,609,895	Stk.	Feb 21	5	6½	South Met. Ord.	99—101	..	99½—100½
102,580	,,	July 10	5	5	Do. Red Pref.	96—98	..	..
1,895,445	,,	,,	3	3	Do. 3 p.c. Deb.	58—61	..	61
734,000	,,	Mar. 6	6½	6½	Do. 6½ p.c. Red. Deb.	103—105	..	104½
91,500	,,	,,	8½	8½	South Shields Con.	136—138d	..	..
1,087,795	,,	Feb. 21	6	6½	South Suburban Ord. 5 p.c.	104—103	+1	..
368,837	,,	June 26	5	5	Do. 5 p.c. Deb.	93—98	..	95—97½
647,740	,,	May 8	6	5	South'mpt'n Ord. 5 p.c. max.	85—88	..	87
121,275	,,	June 26	4	4	Do. 4 p.c. Deb.	73—78	..	..
250,000	,,	Mar. 6	7	7	Swansea 7 p.c. Red. Pref.	104—106	..	..
200,000	,,	June 26	6½	6½	Do. 6½ p.c. Red. Deb.	102—104	..	..
120,000	,,	July 24	8	8	Tottenham District A 5 p.c.	116—119*	..	11½—118
882,275	,,	,,	6½	6½	Do. B 3½ p.c.	99—102*	..	100
181,255	,,	June 12	4	4	Do. 4 p.c. Deb.	76—80	..	77—78
258,251	,,	Mar. 20	5	7/14/4	Tynemouth Con. and New	86—88d	—1	..
					Wandsworth, Wimbledon, and Epsom—			
					Wandsworth A 5 p.c.	132—137	..	..
30,000	,,	July 10	9½	9½	Do. B 3½ p.c.	110—115	..	..
255,636	,,	,,	7½	7½	Do. C	96—101	..	..
108,075	,,	,,	6/7/9	6/9/6	New Ordinary	..	..	..
240,865	,,	,,	6/7/9	6/9/6	Wimbledon 5 p.c.	110—115	..	111½
352,000	,,	,,	7½	7½	Epsom 5 p.c..	113—120	..	..
98,000	,,	,,	7½	7½	3 p.c. Deb.	55—60	..	..
88,416	,,	June 26	3	3				

Quotations at:—*a*.—Bristol, *b*.—Liverpool. *c*.—Nottingham. *d*.—Newcastle. *e*.—Sheffield. * Ex. div.

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Malton Gas Company.—Mr. Hugh W. Pearson presided over the half-yearly meeting of the Malton Gas Company, and in moving the adoption of the report said that, though the balance of profit was £312 less than it was a year ago, it was a satisfactory result, having regard to the reduction made in the price of gas, which had been reduced to 3s. 9d. per 1000 c.ft. A dividend of 6 p.ct. for the half-year, free of income-tax, was declared.

Results at Fleetwood.—The Fleetwood Gas Company report an expenditure of £562 on last year's working; new mains and services having cost £443 and new meters £119. The profit was £2760, reduced by loan interest to £2364. The Directors recommend that this sum should be allocated as follows: Payment of 7½ p.ct. dividend on preference stock (less income-tax), £290; 5 p.ct. dividend on ordinary stock, £895; and carrying forward £1179 to the credit of profit and loss account. The price of gas is to be reduced by 3½d. per 1000 c.ft. from Oct. 1.

Coatbridge Gas Company.—The Directors of the Coatbridge Gas Company, in submitting their balance-sheet and statement of accounts for the year ended June 30 state that the sale of gas amounted to 1,257,233 therms, being an increase of 112,022 therms, or 9·8 p.ct. compared with the previous year. At the forthcoming meeting of shareholders they recommend the payment of dividends at the same rates as last year—viz., £14 5s. p.ct. per annum on the original stock, and £9 19s. 6d. p.ct. per annum on the four issues of £10 shares, all less income-tax.

Glasgow Gas Price to be Reduced.—The Glasgow Corporation Gas Committee have decided to recommend that the charge for gas to domestic consumers be reduced from 3s. 8d. to 3s. 2d. per 1000 c.ft. They also recommend a special concession to industrial consumers taking gas during the day. In making the reduction as much as 6d., the Committee are hoping, by an increased consumption of gas, to assist the air-purification movement in the city. The reduction proposed is the third to be effected in the course of three years, and means that since 1921 the price has been lowered to the extent of 1s. 5d. per 1000 c.ft.

Wellingborough Gas Light Company.—The report of the Directors for the half-year ended June 30 shows that the profit, after deducting income-tax and interest, amounts to £4310. This, added to the balance of £6002 brought forward, makes an available balance of £10,312. The Directors recommend that dividends of 7½ p.ct. on the original, and 6 p.ct. on the additional, shares, less income-tax, be declared for the half-year. This payment will absorb £3846. They further recommend that £720 be carried to the reserve fund, leaving a balance of £5746 to be carried forward. The price of gas for power will be reduced by 6d. per 1000 c.ft. (1·30d. per therm) from Oct. 1 next.

Loan Periods for Gas Plant.—The Bolton Corporation Gas Committee have referred to the Finance Committee, a letter from the Ministry of Health with reference to the application of the Council for sanction to borrow £6400 for the construction of a reinforced concrete tar well, and £15,125 for the provision of a condenser and building for stores and repairs. The Ministry stated that, though section 87 of the Bolton Improvement Act, 1882, fixes a period of sixty years for repayment of moneys borrowed under that Act, the periods allowed by the Ministry for such works as are now proposed are twenty years in respect of the tar well, and thirty years for the condenser and building.

Old Silkstone Collieries, Ltd.—At the annual meeting of the Company, held at Dodworth, near Barnsley, last Thursday, a dividend making 15 p.ct. for the year was declared on the ordinary shares, carrying forward a credit to profit and loss account of £52,495. Sir Archibald Mitchelson, Bart. (Chairman and Managing Director), in moving the adoption of the report and balance-sheet, said that during the past year there had been welcome freedom from labour trouble in the mining industry, but it remained to be seen whether, so far as colliery owners were concerned, peace had not been purchased at too high a price. When the Seven Hours Act was incepted in 1919, one was assured that the output would suffer very little. What happened in 1923? The total production of coal was 9 million tons less than in 1913, though there were in the last quarter of the year over 80,000 more men employed at the mines. The new wages agreement which came into operation in May of this year had put a further increase on production costs, and in some of the poorer districts pits had already closed-down owing to inability to pay the increased wages. It was certain that others would follow.

Reduction at Perth.—The Gas Committee of the Perth Corporation have finished the year with a credit balance of £3626; and it has been agreed to reduce the price of gas from 4s. 2d. to 3s. 9d. per 1000 c.ft. A reduction of about 10 p.ct. is to be made in the price of gas for heating and other purposes.

Tralee Gas Strike.—The employees of the Tralee Gas-Works went on strike last week, since when the town has been without a gas supply. It appears that when the local carters struck on a small question as to charge for horses and the number to be assigned to each man the gas-works went out in sympathy. The Urban Council then agreed to the carters' demand of "one man one horse," and these men returned to work; but the Council refused a claim by the gas-workers for payment for the time they had lost by being out, and decided that in the circumstances they should remain out.

Tipton Gas Affairs.—In his financial statement to the Tipton Urban Council on the year's working of the gas undertakings, Mr. Salter (chairman of the Gas Committee, said that as a result of the year's profits they were able to reduce the price of gas by 3d. per 1000 c.ft.—from 4s. to 3s. 9d. for private lighting and street lighting, 3s. 9d. to 3s. 6d. for power gas below the consumption of 100,000 c.ft., and 3s. 6d. to 3s. 3d. for quantities greater than this. Three years ago they had an overdraft of £15,000 to £16,000, and this had now practically been wiped out. In 1914 they carbonized 12,563 tons of coal, and produced 152,316,000 c.ft. of gas; but in the year just ended they produced 187,039,000 c.ft. from 12,369 tons of coal. At present, they had outstanding loans of £50,000; and on this outlay they made a gross profit of £11,277. The net profit for the year was £5166.

Newry Gas Undertaking.—Following an inspection of the Newry Gas-Works, Mr. R. G. Shadbolt, Consulting Engineer, of Manchester, reported to the Gas Committee that he was pleased to find that many improvements had been carried out on the lines of suggestions which he had made on a previous occasion, with a resulting increase in general efficiency. Buildings had been well maintained, and the heavy demands during winter had been met with an excellent working margin of surplus retorts. The holders were in better working order than before. Pressure in the mains was satisfactory, and leakage had decreased from 16·5 p.ct. to 8·9 p.ct.; while the quantity of gas accounted for had risen from 12,227 c.ft. per ton of coal used to 15,142 c.ft. The balance to credit of revenue account was £3892, an increase of £1535; but as the price of gas had been reduced 10d. per 1000 c.ft. for the current year (representing a sum of £1574) this advantage had been handed over to consumers, and further reductions were inadvisable until costs of production had further decreased.

The Crieff Gas Company, at their annual meeting, declared a dividend of 7½ p.ct.

The Bewdley Town Council have accepted the tender of the Bewdley Gas Company for the lighting of public lamps for the year, at a cost of £156.

The Willenhall Urban Council have accepted the tender of the Willenhall Gas Company, amounting to £830, for the lighting of 234 public lamps from Sept. 1 next to April 30.

It is stated by "The Times" that gas-lit coaches and goods vans have been forbidden on the Swiss railways. This prohibition is a result of the Bellinzona accident of April 23, which was aggravated by the fact that a German gas-lit coach took fire.

A serious loss of gas was reported by the Ashburton Gas Committee at a recent meeting of the Urban District Council. The amount of gas made was 5,365,300 c.ft., of which 948,000 c.ft. was unaccounted for. It was stated that a length of pipe had been taken up recently, and found to be perforated and much corroded. As a result of the year's working, there was a credit balance of £76; the income amounting to £2122, and the expenditure to £2046.

The extinguishing of street lights at Plymouth at midnight has been strongly protested against many times since summer time commenced; but the ground of complaints previously has been that night workers and others have come into contact with lamp-posts and other obstructions on dark nights. Last week, however, there was an alarming incident which points to another danger; a man being attacked by half-a-dozen hooligans in one of the principal thoroughfares. The attack was most cowardly, for the victim is crippled through war service and half-blinded through an accident.

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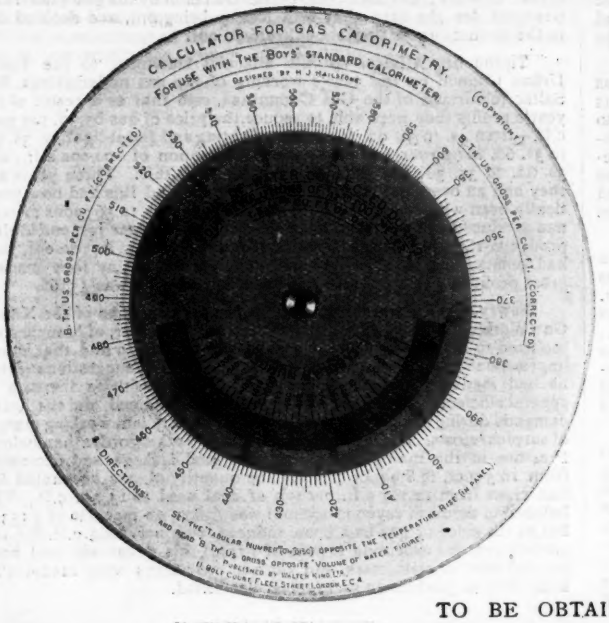
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